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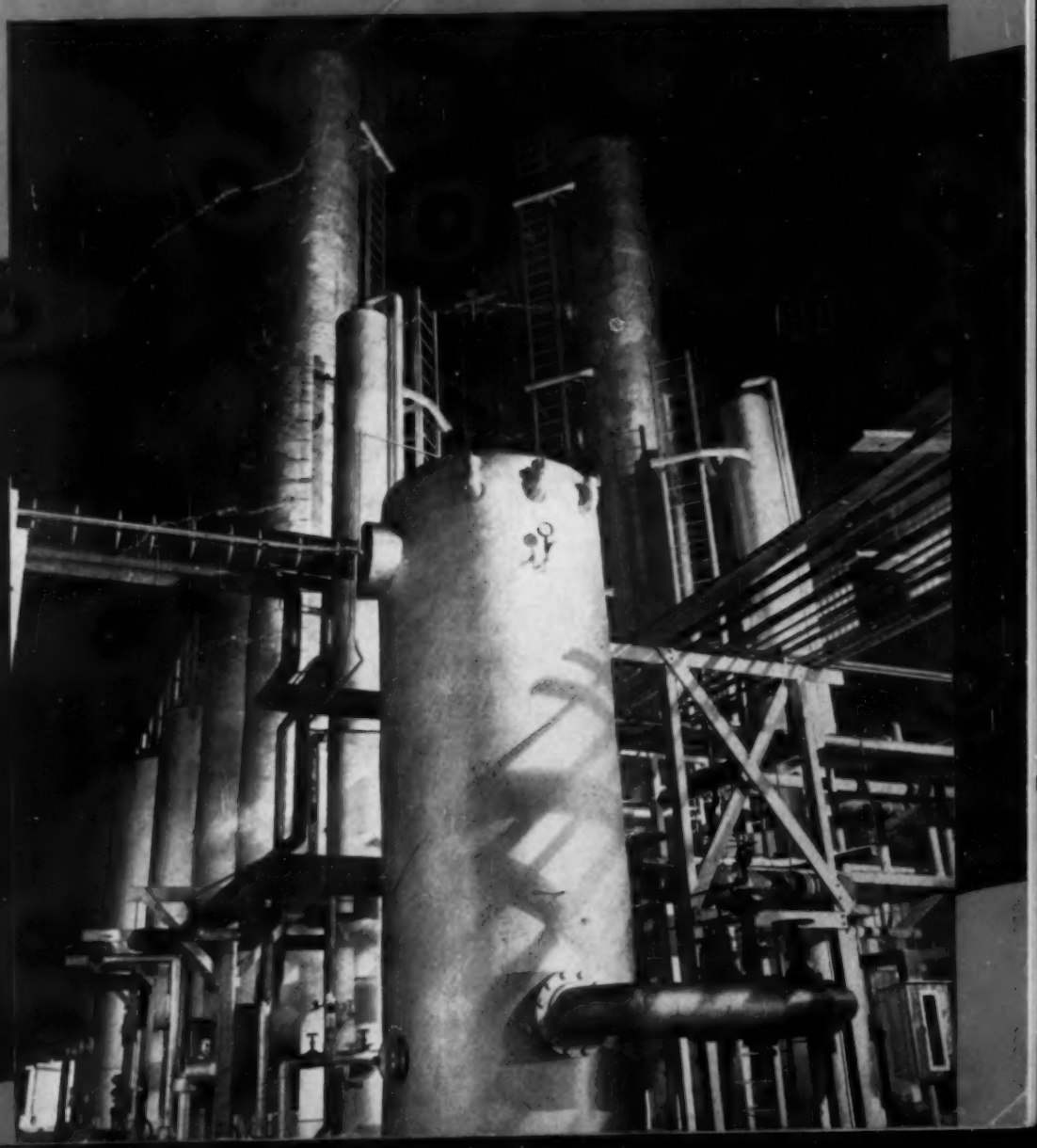

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Volume 54 Number 12

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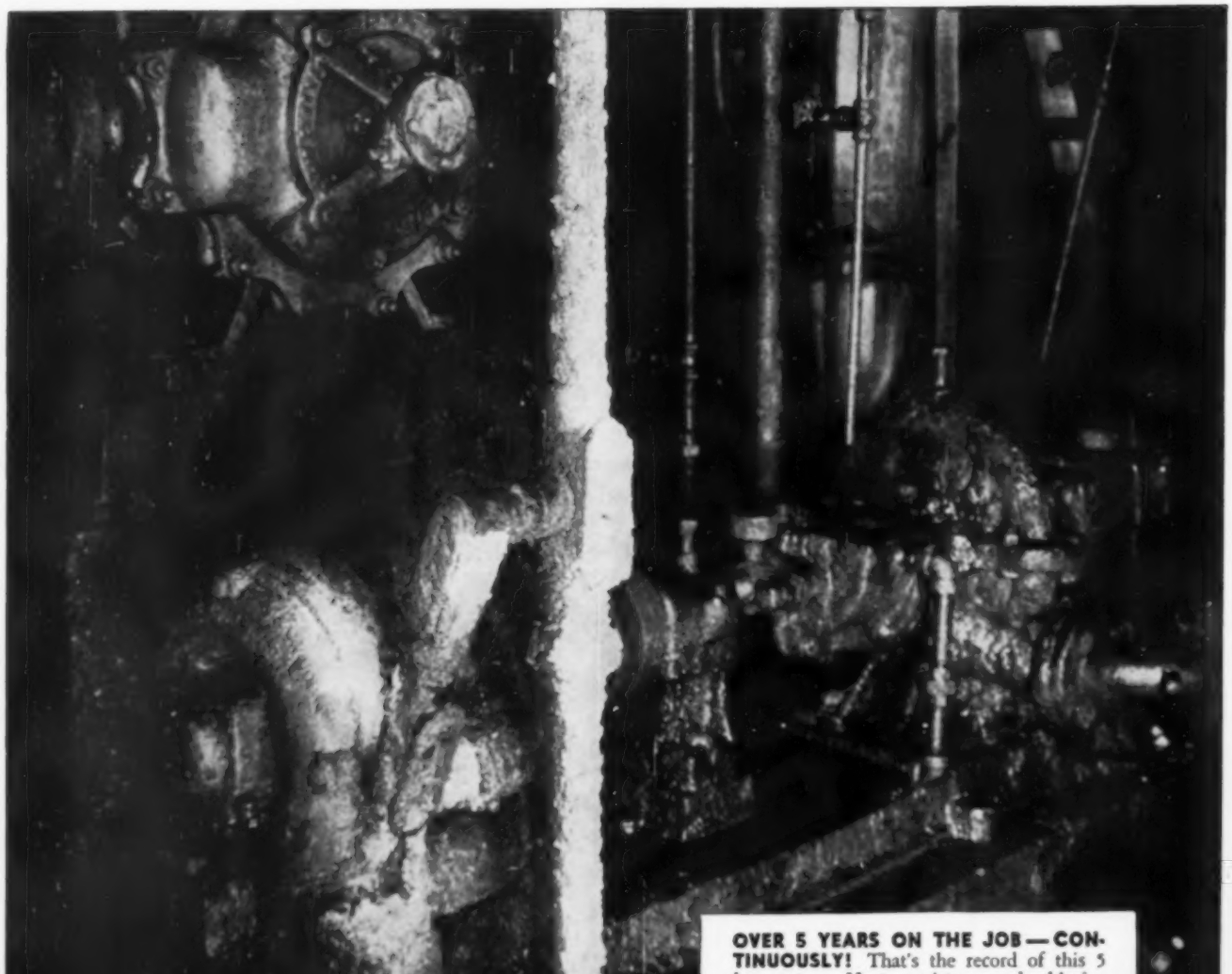

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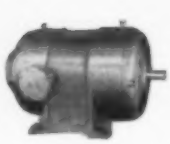

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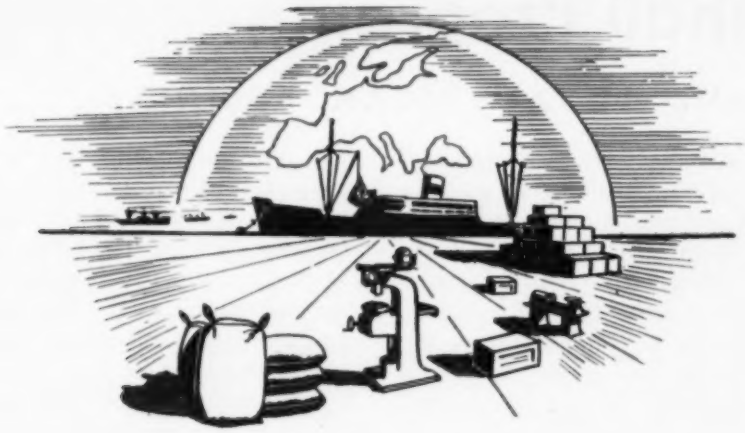


The Marshall Program

WHAT WILL THE MARSHALL PROGRAM mean to American business? What industries will be called upon to meet the needs, and how great are they likely to be? Will the program carry with it another dose of inflation? Are new bottlenecks being created, or will old ones gain a new lease on life? Where are material shortages likely to fall most heavily?

These and a hundred other questions are in the minds of many American businessmen today. Unfortunately, no final or precise answer can be given to some of them. And it is in the nature of the problem which the Marshall program tackles – that of getting Western Europe on a steady economic foundation – that no precise answers are going to be possible. We have only to view the bad breaks Europe has collected since V-J Day, including the blizzards and drought of this past year, to see how the economic picture can change on short notice.

Nonetheless, the broad dimensions of a Marshall program are sufficiently clear to permit more than a guess about its impact on American business. Both here and abroad committees have been busy for months shaping up Western Europe's rehabilitation needs. At the same time a mine of information has been pulled together about our own output and capacity. The result is a small library of technical reports which carry most of the facts Congress needs for a decision on the immediate problem.

McGraw-Hill's Department of Economics has waded through these reports and queried industry itself to determine the likely effect of the Marshall program on American business. This report carries the main results of their investigation.

One conclusion emerges clear-cut. American business can not provide the assistance Western Europe will need without considerable cost to itself. Such costs are outweighed by the gains that can be expected, economic and social, as well as political. Nevertheless, business will want to anticipate those difficulties that might arise and move to overcome them. The following pages, therefore, highlight both the problems and the benefits that are likely to fall to American business as a result of the Marshall program.

★ ★ ★ ★ ★ ★ ★ ★ ★

The Marshall Program

WHAT IT MEANS TO AMERICAN BUSINESS

WESTERN EUROPE'S INDUSTRIAL MACHINE has picked up considerable speed since V-J Day. But vital gears are not meshing and industry isn't getting the job done that is necessary. The things people most need are those that are lacking. Food output is down more than a fourth. Coal production is lower by a fifth. The net result is a living standard that ranges from bare subsistence in some countries to a level far short of prewar in others. And even this depends on imports for which the area can't pay.

This melancholy economic picture has its political counterpart. The best organized and the most energetic political party in France and Italy is Communist. While the Communists in Germany and Austria are less strong, they still are an element to be reckoned with. These are all key areas which, should they fall within the orbit of an unfriendly power, could well destroy the freedom of political action throughout all of Western Europe.

Needless to say, such a development would have military implications of the utmost importance. It is a military axiom that any defense must be organized in depth. And in the event of any emergency "depth" for the United States must now include Western Europe.

It is this complex mixture of the economic, political, and military, then, that has led to the Marshall program. Underlying this program is a deep conviction: That Western Europe possesses the skills and resources necessary to work out its own economic salvation. The fact that in two years it has not done so reflects both the depth of the wounds it suffered in war and the bad breaks it has received since then. With time these skills and resources can reassert themselves. Meanwhile, food, equipment, and materials from America will shorten the job and enable Western Europe to stay on its feet.

Western Europe's Program

SECRETARY MARSHALL gave the program that bears his name its initial push. But it is Western Europe which quickly seized the initiative. A committee of 16 nations met and surveyed their needs and resources. From this survey grew a broad program designed to achieve a balance between the economies of Western Europe and the rest of the world by 1952. Moreover, the program seeks such a balance while raising the standard of living close to that of pre-war days. Hunger and disorder which force extreme social change might thus be eliminated.

As developed thus far Western Europe's economic program is not a detailed plan of action. It does, however, lay out the terrain that must be covered if its objectives are to be reached. Four fields are staked out for action. One involves an immense effort on the part of the cooperating nations to raise their own capacity and output. A second requires the establishment of internal financial stability in countries like France and Italy that now lack it. A third looks forward to closer economic cooperation between the participating countries on a more permanent basis. Finally, a fourth lays out the extent and nature of the aid which Western Europe will require from the United States and the rest of the Western Hemisphere.

It is this fourth aspect of Western Europe's program that is of primary concern to us here. Nevertheless, the hard core of the Marshall Plan is that aid alone can not solve Europe's problem. And it is no exaggeration to say that the most important features of any program are those which Europe itself must fulfill. In this regard, nothing is more critical than the goals set for an expanded capacity and production.

THE PRODUCTION GOALS

Europe's production goals also have an importance for American business. They suggest lines in which Europe eventually will become independent of the United States, as well as competitive in world markets. Here are some of their highlights:

a) An increase of steel ingot production to 61 million tons, a fifth higher than 1938.
b) Development of oil refining capacity to 2½ times pre-war (largely for refining imported crude).
c) Increase of coal output to 644 million tons (U.S. output in 1947 is around 600 million tons).
d) Rapid advance in the output of electrical products—needed in part to help equip a 25 million kw expansion of generating capacity.
e) A large increase in capacity of other key equipment industries; e.g., mine equipment, petroleum equipment, farm machinery, construction equipment.
f) Restoration of pre-war output of bread grains and cereals; expansion in sugar, potatoes, fats and oils.
g) Restoration of merchant fleets to pre-war size.

These are very ambitious goals. They call for a great advance from the current position, as the chart on the next text page shows. In some aspects (electricity, foodstuffs, perhaps coal, are examples) they appear unlikely to be met, at least by 1952. Such a development would, of course, modify the import list.

THE IMPORT REQUIREMENTS

To do the job that confronts it Western Europe has said it needs more than $20.5 billion of goods and services from this country over a period of four years. In return it would plan to offer us goods and services to the value of $4.7 billion. That leaves a whopping deficit of about $16 billion. The heaviest commodity export ($6 billion) – and the biggest chunk of the deficit – would arise next year. Thereafter, exports would fall off about

(Continued on page after next)

Coal: KEY TO RECOVERY

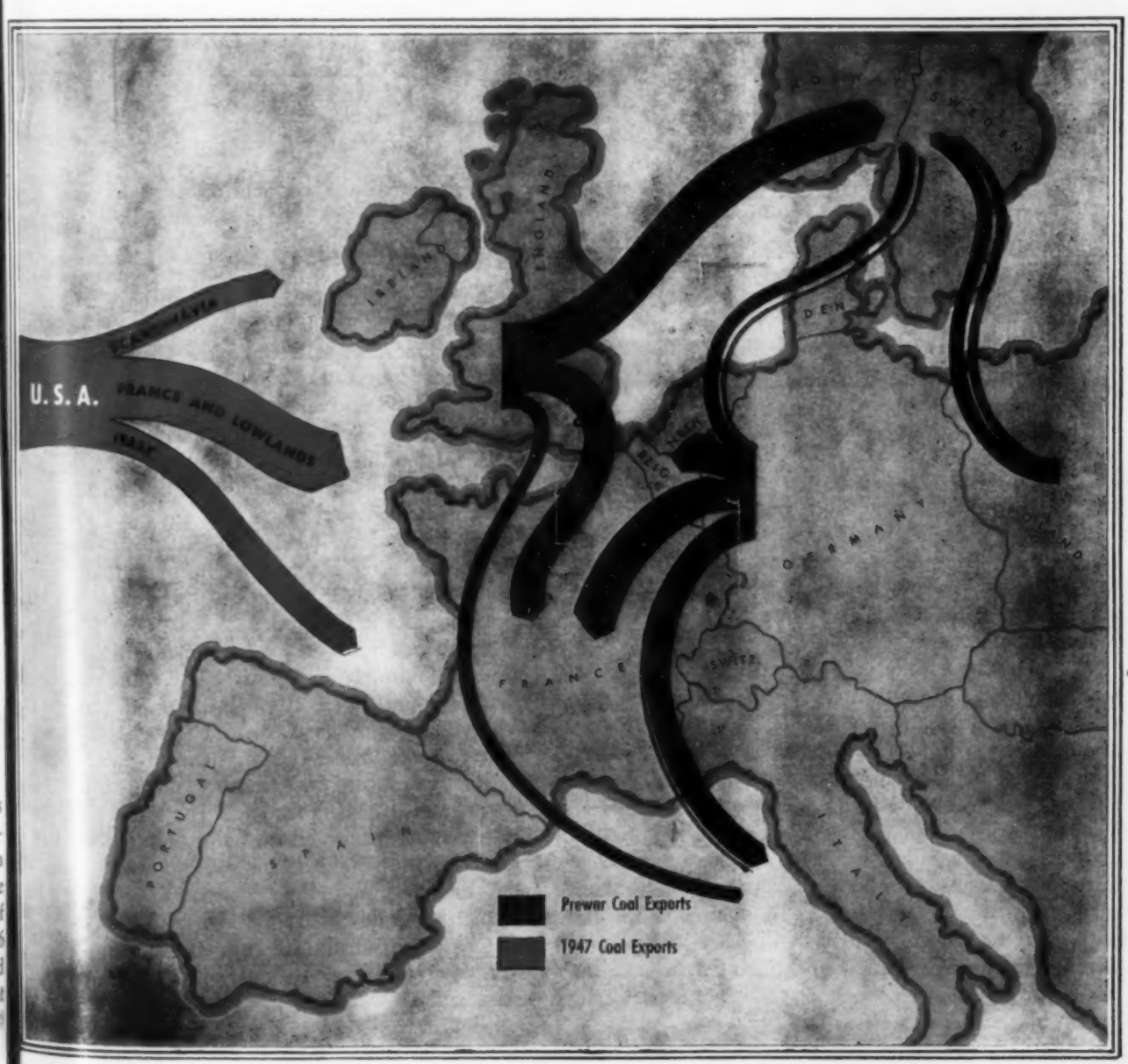
COAL IS AT THE HEART of what is wrong with European industry today. Because of the lack of coal, factories run part time, fields are less fertile, and firesides are cold.

What Western Europe plans to do about coal is typical of what it plans to do about industry generally. The job is to expand output in its own producing centers, resume exports within the region, and cut down costly and unnecessary imports from the United States.

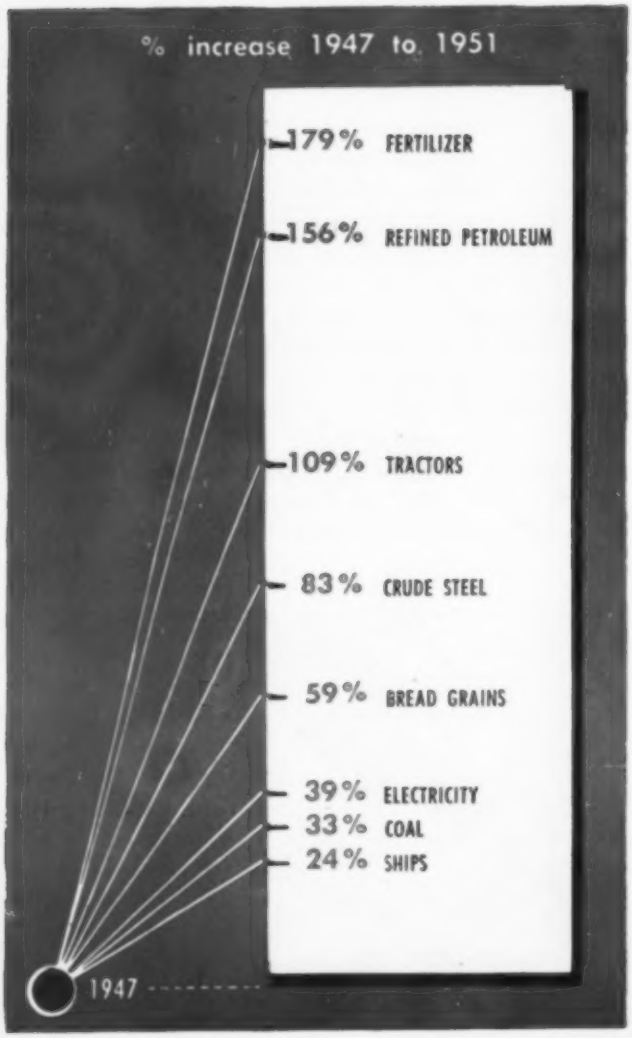
In the case of coal this means restoring a flow which in pre-war days was the life-blood of Europe's industry. As the map shows, two great coal centers – Britain and Germany – supplied not only their own nationals but the needs of other countries as well. Today Britain can't meet its own requirements and coal production in the Ruhr is but half of what it was. The result is the costly necessity to haul coal from the United States.

Western Europe will need 45.2 million short tons of U.S. coal next year. Meanwhile, it plans to build up its own production. By 1951 it hopes to turn out coal at more than the pre-war rate, with Britain and the Ruhr sending sizeable shipments to their neighbors. Coal from the U.S. will have been cut to 6.6 million tons.

Two developments are vital. First, Western Europe must reequip its mines. This calls for a vast production effort on its own part, as well as the import of specialized equipment from the U.S. Second, a river of coal, 34.2 million tons in 1951, must breach the iron curtain and flow from Poland to the West.



Western Europe's Production Goals



one-third to a total of $4.1 billion in 1951.

Nor is the U. S. the only base from which Europe needs vital supplies for which it can't pay. Canada and Latin America are asked to shoulder a trade deficit that comes to almost $6 billions for the four years. Needless to say, if food and raw materials are not available on credit from these areas, the larger will be the sum required from the U. S.

There already is considerable debate about these figures. There will be a lot more while Congress considers the aid program. The fact is, and this is the conclusion at which the President's Committee on Foreign Aid arrived, no final estimate of how much Western Europe's needs might cost over four years can be made. Crops, industrial production, prices, trade relationships and a host of other factors may turn out differently than anyone now expects. For this reason the United States may choose to review Western Europe's progress and its import needs on a yearly basis, rather than fix in detail a four year program. For the same reason our discussion of Western Europe's requirements concentrates largely on the picture in 1948.

As it now stands, the list of items that Europe wants to get from us is more general than specific. Moreover, inter-departmental committees have taken the list and pared it down, chiefly on grounds the supplies are not available. Here is the way the general categories shape up, both as initially requested and as revised. The figures represent total imports and are in millions of dollars.

	European Committee Estimate for 1948	Estimate for 1948 as revised	European Committee Estimate 1948-52
Food, Feed, and Fertilizer	1,500	1,270	5,400
Cotton	400	350	2,000
Coal	340	370	700
Iron and Steel Products	370	230	1,200
Petroleum Products	510	485	2,200
Chemicals	250	200	850
Timber	100	95	400
Farm Machinery	370	100	1,100
Inland Transport Equipment	200	60	490
Petroleum Equipment	170	130	555
Mining Machinery	80	80	220
Electrical Equipment	150	125	500
Machine Tools and other Machinery	545	450	1,750
Miscellaneous	1,065	1,065	3,030
	6,050	5,010	20,395

A quick glance behind these totals reveals the following:

Among agricultural supplies breadgrains and feedstuffs are the big items. Dairy products and fats and oils are also sizeable.

Of the $2 billion or more of petroleum products three-fourths are refined and one-fourth is crude.

Coal shipments will bulk large the first year (45 million tons) but they fall off rapidly thereafter.

The steel request originally included 1.5 million tons of scrap in 1948 and more thereafter. This isn't available. Of the finished items, sheet and tin plate come to 744,000 tons in 1948, the peak year.

The chemicals wanted are industrial chemicals, paints and medicinals as well as a lot of unnamed specialties.

The huge catch-all labeled miscellaneous covers textiles and whatever additional consumer manufactures Europe will seek. Aircraft and surplus ships are other important items in the group.

A number of items on the equipment list could cause considerable trouble. Farm machinery, mine equipment, refining equipment, electrical apparatus, and freight cars are among these. Each is examined in detail below.

These exports under the Marshall program, if carried out, will affect all of U. S. business down to the corner grocery store. In many instances the impact will be so slight and indirect as to be hardly noticeable. But in a few industries the program will loom as a major element, dictating production patterns and setting a limit to capital expansion plans.

It's hard to paint a simple picture of a situation as diverse as this. We try to do so below by dividing the effects of the Marshall program into several broad groups. First we consider the impact of the program

the general level of business. Next, we cover the impact on leading industries – steel, oil, electrical equipment, farm machinery, and the like – and the effect on business through the creation of shortages in these items. Finally, we examine the influence of the program on farm prices and living costs.

THE OVER-ALL LOOK

The Marshall program comes at a time when certain demands contributing great inflationary pressure on business are beginning to slacken. While it will help hold business at a high level, the program itself is not great enough to maintain a general inflationary pressure. Nevertheless, it will give new strength to shortages that have been troublesome to business. In these latter areas, as well as on the food front, prices will continue firm and may go even higher.

If the program is carried out along lines described above exports to Europe will run about $5 billion. The gain here will offset a decline that has already begun in U.S. exports to other areas. After a careful study of these divergent trends, we conclude the end result is likely to be a total export of goods at a rate of about $15 billion in 1948. However, this rate will only be reached after the program starts rolling. The sale of services – shipping, tourist and the like – will add another $2.5 billion to our foreign account. Moreover, this over-all sum of $17.5 billion probably will run about $9 or $10 billion greater than our imports.

Under the Marshall program, then, our foreign trade in 1948 will be carried toward the peak that prevailed in second-quarter 1947. But the over-all inflationary impact of exports in 1948 is bound to be less than it was in second quarter 1947. Not only is our capacity to produce growing, but certain elements in our domestic demand are almost certain to be less strong next year.

This last fact is important and needs to be spelled out. Indeed, it's impossible to determine the effects of the Marshall program without some idea of what would happen to business without it. The accompanying chart which shows how our gross product has been split up in the past several years serves as the starting point for such an estimate. There it can be seen that the spending of domestic consumers takes the biggest slice of the gross product ($164 billion). However, the share going to business and to government also has been sizeable (about $30 billion each). Alongside each of these the net expenditure of foreigners on our goods seems small. Nevertheless, it has a tremendous importance to a huge number of business firms and industries.

Left by themselves, the spending of consumers and of government would be likely to fall very little if at all next year. But business outlays – spending on plant, equipment, inventories, and residential housing – are another matter. Here the vulnerable items are plant and equipment. Capital expansion has been extraordinarily large for two years, and in not a few cases business is completing its initial post-war program of capacity expansion. Therefore, some decline, but not a large one, is expected in the aggregate of business spending during 1948. This in turn would have some reaction – but again a minor one – on the spending of consumers.

The net effect of such developments should be to place industry in a better position to meet the pressing needs of the Marshall program. This does not mean, however, that the program can be handled without difficulty. The trouble is that many of the items Western Europe most needs are those which would, under normal conditions, continue in tight supply. It is these bottlenecks that business will want to anticipate and, to the extent possible, overcome. Here are the facts concerning the most important of them.

COAL: TRANSPORT IS THE DIFFICULTY

Western Europe wants 45 million tons of coal from the U.S. in 1948. Thereafter requirements drop sharply to 6½ million tons in 1951.

U.S. production of bituminous next year ought to equal the 600 million tons turned out in 1947. If it does we can meet Europe's need. However, the job will call for careful scheduling of delivery. For the real problem in coal is a shortage of coal cars. This has plagued industrial consumers in 1947. Unless car turn-around times are improved (they now average 14 days as against 11 during the war) car shortages will continue through 1948. Under such circumstances, exports to Europe won't permit the accumulation of normal stockpiles – a fact managements in many industries won't like.

Any actual shortage in production that might develop will be limited to special types of coal – particularly the better grades of coking and by-product coal. Europe has concentrated largely on these. Such concentration isn't necessary, but since transport costs (the big element for Europe) are about the same for all grades, Europe has

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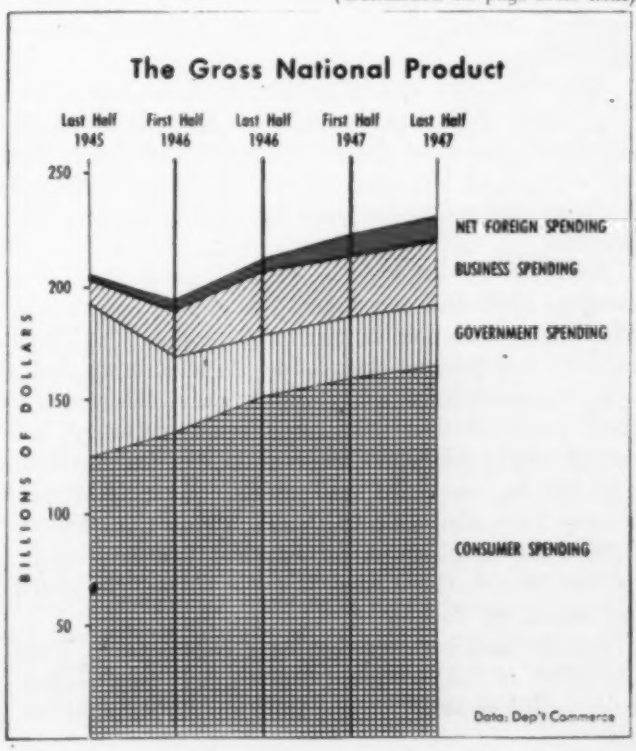

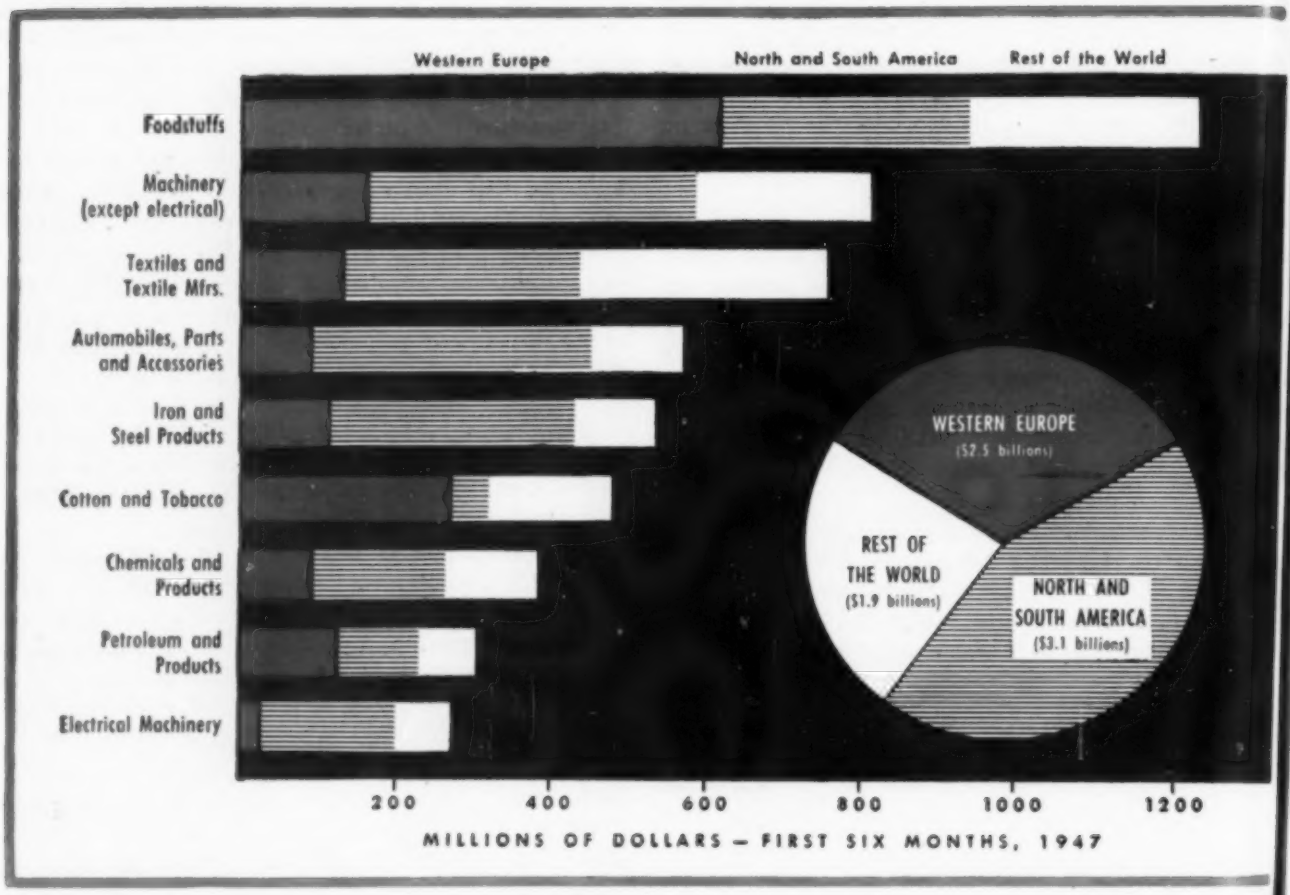

U. S. EXPORTS . . . Where they go — What they are

U. S. EXPORTS THIS YEAR hit an all time high. Shipments in the first six months were at an annual rate of $15 billion, four times the pre-war rate. Since then they have declined, but not greatly. The export rate now is about $13 billion.

Foodstuffs have moved to the top of the export list. The needs of Europe combined with crop failure in Southeast Asia have revived an export that before the war seemed all but dead. About half this record flow has been directed to countries included in the Marshall program.

Next on the list are the durable goods that have come to symbolize the strength of American industry. Machinery, automobiles, and steel products are all in extraordinary demand abroad. In spite of domestic shortages, shipments have been relatively heavy. Thus in one form or another about 18% of our tight steel supply has moved abroad this year. Canada and Latin America have been the big customers, and sizeable quantities of machinery have also gone to Russia. Other than France (which had a big loan for the purpose) Western Europe has not been in the market. They've needed the goods but lacked the dollars.

Textiles have been another huge export group. Here the influx of new foreign customers has been warmly welcomed. For heavy buying from abroad has kept textile output going at a good pace.

Cotton, tobacco, oil, and chemicals are other supplies that bulk large in U.S. trade. Western Europe has been a principal buyer of all except chemicals. Canada and Latin America again have been at the head of the line for these last items.

Regardless of the Marshall Program, some shift in U.S. export trade could be expected in 1948. The recent splurge of foreign buying cannot be maintained if for no other reason than that funds will not be available. U.S. import of goods and services – the chief source of dollars for most of the world – has been only 40% of exports. About $10 billion of loans and relief grants helped keep Europe in the market. At the same time, foreign nations drew down dollar balances and shipped gold.

Net effect of the Marshall program on exports is to provide $4 to $5 billion of trade that otherwise is lacking. Not all this added trade need be with Europe. If the U.S. provides dollars for Western Europe to buy in Latin America and Canada—which it well might—those areas will spend more here. Nevertheless, under the Marshall program much more of our trade will be directed toward Western Europe and the things it wants. These are foodstuffs, industrial supplies, and machinery. Little in the way of textiles or automotive equipment is on Western Europe's shopping list.

sought the best. U. S. utilities, steel and gas manufacturers, and the Great Lakes trade are large domestic users of these fuels. They will continue to feel competitive pressure unless Europe's buying habits are changed.

PETROLEUM — WORLD-WIDE SHORTAGE

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All this is not to say that the export of oil from the U. S. proper is not considerable. It is, with exports this year running at a rate of more than $600 million. About $250 million of this—chiefly refined products—has gone to Europe. From the standpoint of refining capacity alone, shipments of refined products from the U. S. could, in a pinch, be stepped up slightly. But capacity also should be available in the Caribbean and the Middle East. It makes economic sense to ship from these other areas and they should get the business.

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Nitrogen fertilizer is the one U. S. chemical product high on Western Europe's priority list. Industrial chemicals and pharmaceuticals are wanted, but are not likely to be purchased in quantity if funds run low.

Nitrogen, of course, is in extremely short supply the world over. Moreover, this shortage probably will not be licked until the early Fifties. If Western Europe were to receive the full 319,700 tons of nitrogen it desires from the Western Hemisphere in 1948, consumption in the U. S. would of necessity be reduced. Not only would commercial exports have to be increased, U. S. imports would also decline. Large supplies (180,000 tons) from Canada and Latin America make the U. S. a net importer on commercial account.

The likelihood is that Western Europe will get more nitrogen next year than this. However, the advance will come out of a small expansion of production, leaving U. S. consumption what it was. From the U. S. some 70,000 tons (6½% of production) may be shipped. This would equal commercial exports to all areas in 1947.

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Among other chemical products, Western Europe would like the following (figures are millions of dollars).

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Industrial Chemicals	50	190
Paints and Pigments	40	145
Coal Tar products, Medicinals, etc.	160	515
	250	850

No forecast of our actual export of these products is possible. However, shipments are likely to run considerably lower than the above figures suggest. Western European production can fill the most essential needs. Since supplies here are very tight on many items, exports to Europe may not greatly exceed those of 1947.

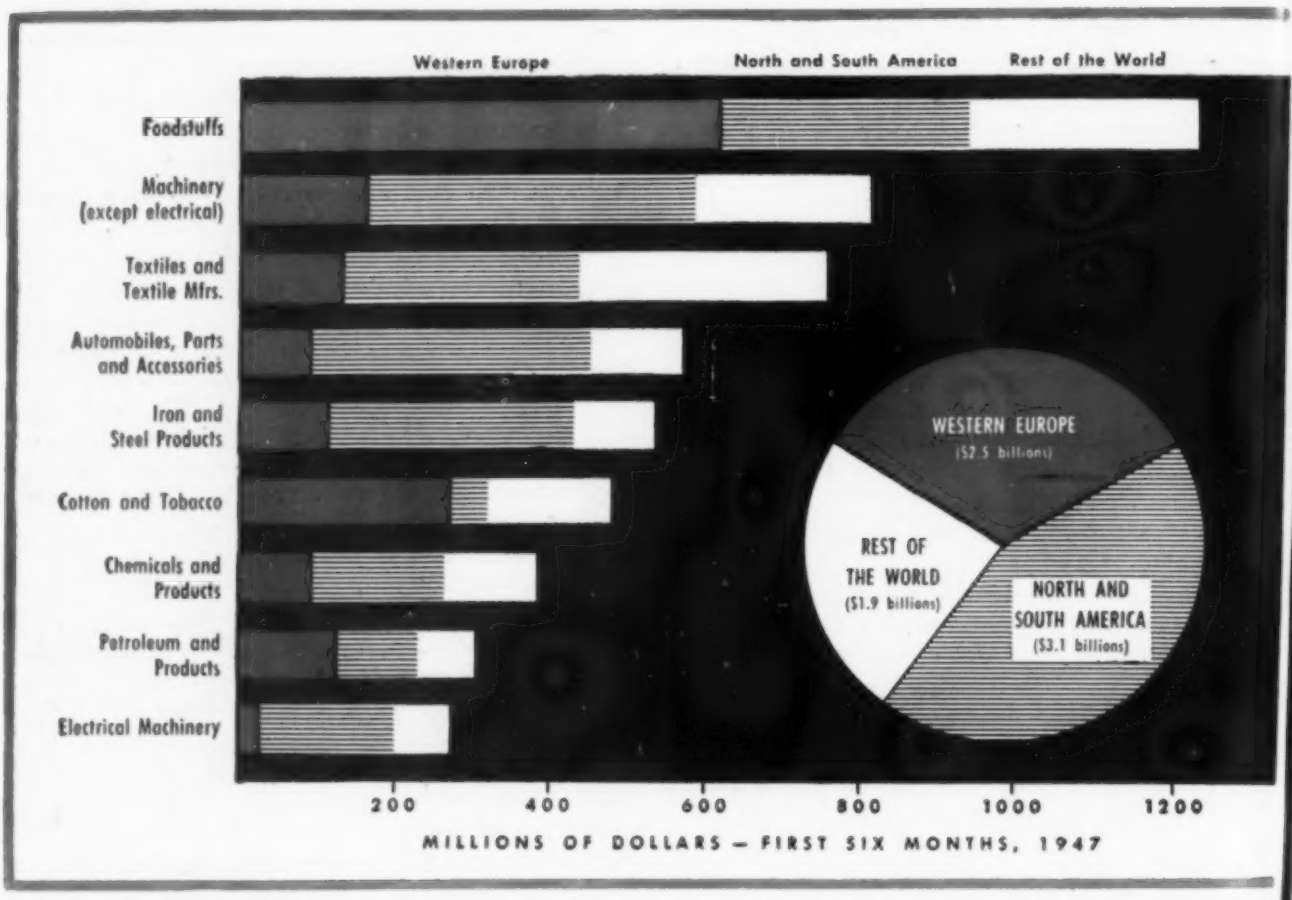
STEEL — STILL THE NO. 1 PROBLEM

No material caused more trouble for U. S. industry in 1947 than steel. The extent of the shortage in 1948 – and the possibility that it might end – has been a key element in the plans of many producers for next year. Under such circumstances the needs of Western Europe are bound to be weighed and measured with care.

Here is what the initial report from Paris asked for in the way of steel (figures in thousands of tons).

	1948	1949	1950	1951	Total
Ingots and semi-finished items	2,244	2,299	2,475	2,387	9,405
Sheet and strip	424	198	34	...	656
Tin plate	320	314	296	275	1,205
Other finished steel	500	...	...	...	500
TOTAL	3,488	2,811	2,805	2,662	11,766
Steel scrap	1,500	2,000	2,300	2,500	8,300

At first glance these requirements don't appear too hard to meet. This year we have been sending steel abroad at the rate of 6.2 million tons annually. Canada and Latin America took more than 3.5 million tons of this. Europe took only about 2 million tons. Apparently the problem could be solved by shifting exports.



U. S. EXPORTS . . . Where they go — What they are

U. S. EXPORTS THIS YEAR hit an all time high. Shipments in the first six months were at an annual rate of $15 billion, four times the pre-war rate. Since then they have declined, but not greatly. The export rate now is about $13 billion.

Foodstuffs have moved to the top of the export list. The needs of Europe combined with crop failure in Southeast Asia have revived an export that before the war seemed all but dead. About half this record flow has been directed to countries included in the Marshall program.

Next on the list are the durable goods that have come to symbolize the strength of American industry. Machinery, automobiles, and steel products are all in extraordinary demand abroad. In spite of domestic shortages, shipments have been relatively heavy. Thus in one form or another about 18% of our tight steel supply has moved abroad this year. Canada and Latin America have been the big customers, and sizeable quantities of machinery have also gone to Russia. Other than France (which had a big loan for the purpose) Western Europe has not been in the market. They've needed the goods but lacked the dollars.

Textiles have been another huge export group. Here the influx of new foreign customers has been warmly welcomed. For heavy buying from abroad has kept textile output going at a good pace.

Cotton, tobacco, oil, and chemicals are other supplies that bulk large in U.S. trade. Western Europe has been a principal buyer of all except chemicals. Canada and Latin America again have been at the head of the line for these last items.

Regardless of the Marshall Program, some shift in U.S. export trade could be expected in 1948. The recent splurge of foreign buying cannot be maintained if for no other reason than that funds will not be available. U.S. import of goods and services – the chief source of dollars for most of the world – has been only 40% of exports. About $10 billion of loans and relief grants helped keep Europe in the market. At the same time, foreign nations drew down dollar balances and shipped gold.

Net effect of the Marshall program on exports is to provide $4 to $5 billion of trade that otherwise is lacking. Not all this added trade need be with Europe. If the U.S. provides dollars for Western Europe to buy in Latin America and Canada–which it well might–those areas will spend more here. Nevertheless, under the Marshall program much more of our trade will be directed toward Western Europe and the things it wants. These are foodstuffs, industrial supplies, and machinery. Little in the way of textiles or automotive equipment is on Western Europe's shopping list.

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Unfortunately, the answer is not as simple as this. What Western Europe wants – it's really Britain and Italy that want it – are steel ingots and other semi-finished items (billets, blooms, etc.). These the U. S. has been consuming itself. Exports have been almost entirely in the form of finished products.

From the standpoint of the steel industry, shipment of semi-finished items has two bad results. Certain finishing capacity would be made idle. As a matter of fact, the amount of semi-finished steel Western Europe wants is 40% of the supply non-integrated producers of steel products have been able to get from the integrated producers (who turn out the ingots). In addition, badly needed scrap from the finishing process would be lost.

The Dilemma in Steel

What we shall do about this hadn't been settled yet. Those of the President's Advisory Committee on Foreign Aid who specifically studied the question felt very little semi-finished steel should go abroad. This, however, would hit Western Europe hard. A likely compromise – and one suggested by the Government agencies reviewing Western Europe's requirements – would substitute finished items for semi-finished. Shipments of the latter in 1948 would be held to around 650,000 tons, less than a third of the initial request. But export of finished steel (other than sheets or tin plate) would jump to 1,150,000 tons. On one matter, however, all seem agreed. No straight scrap can be sent. The U. S. just doesn't have it.

Where does the steel consumer stand on all this? From his point of view the export of any steel makes life more difficult. No matter what is shipped he will feel it next year. Here is the probable situation under either the initial request or as it may be revised.

a) Overall the supply will remain about as tight as it has been this year. Although demand on the part of equipment producers is expected to decline somewhat, this will be offset by heavier requirements for construction, transport, and export. Late in 1948 and early in 1949, addition of 2.5 million tons of basic ingot capacity may help somewhat.

b) Steel sheets will continue to be a headache, but probably slightly less of a one than in 1947. Long awaited additions to capacity are beginning to come in. By the end of 1948 the total should stand 3 million tons higher than at mid-1947 (a gain of about 18%). Western Europe probably won't get all it has asked for. Shipments might not exceed 225,000 tons, half the initial request. And most of the increase over the export this year (164,000 tons) is likely to come out of shipments that have been going to other areas.

c) Tin plate also seems destined to remain tight. But here the trouble is as much tin as steel. Exports this year are 561,000 tons, but only a fourth has been shipped to Western Europe. If Europe's requirement of 320,000 tons is to be met, other world areas will probably bear much of the burden.

EQUIPMENT BOTTLENECKS – COAL EQUIPMENT

The equipment items are the toughest part of the Marshall program to assess accurately. The European Committee itself failed to develop any clear-cut list of what will be needed. The large sum labeled "mine equipment," for example, includes a certain amount of electrical apparatus. And no detailed breakdown whatsoever was initially presented for the broad equipment groups listed earlier. Some of these shortcomings will be rectified by information now being obtained. In the meantime, equipments lines where the added needs of Western Europe undoubtedly will cause difficulty can be earmarked.

Coal equipment is one such item. The total of $80 million which Western Europe wants in 1948 is half again as much as our export to the entire world this year. Today order backlogs run from 6 to 24 months on many types of mine equipment. Fortunately, some that are most tight – mine locomotives, coal loaders, coal cutters (except the long wall type) – apparently are not wanted by Western Europe in quantity.

Equipment that is needed quickly includes pneumatic tools, conveyor belting, and long wall cutters. These are all adaptable to European mining and can relieve bottle necks that now exist in supply. Conveyor belting is the most difficult of these items. However, the main trouble in meeting Western Europe's coal equipment needs may arise from another direction – the supply of machinery, parts, and materials for producers of mine equipment in Britain and on the continent. Without help, European plants can't meet the production schedules set for them.

PETROLEUM EQUIPMENT

Western Europe may spend about $130 million on U. S. petroleum equipment next year. This is three fourths of what was originally planned, but it comes close to our total export of petroleum equipment in 1947. The entire expansion program projected by Western Europe's oil industry will run to some $1.8 billion in four years, with a third for U. S. equipment.

Big items needed probably will include steel pipe and tubes, pumps of many sizes, large vessels (fractionating towers), turbo-generators, and well drilling apparatus and parts. Probably the most difficult problem here is steel tubing. Orders are now on the books for production into 1951. Very little has been exported, and what Europe gets in 1948 will clearly be at the expense of domestic consumers. Other trouble spots are pumps, turbo-generators and large vessels.

Our own petroleum industry is undertaking a record capital outlay on production and refining of about $3 billion this year and next. Part of this is in the Middle East and Western Europe itself. Therefore Western Europe's oil industry will compete with American companies for scarce equipment and supplies. Such competition is to be expected in Europe, as well as here.

Since the American program is much further advanced, Western Europe's expansion plans may well lag. This certainly is likely to be the case in the Middle East. Almost half the U. S. equipment wanted by British and French companies is for projects in that area. Many of these require the help of American engineering firms, since U. S. engineers are most familiar with recent developments in installation and design. This engineering talent is itself a scarce element in the petroleum expansion scheme. It may prove the factor that sets a slower pace than Western Europe had planned.

FREIGHT CARS — DELIVERIES LAG

Freight cars for Germany are the only import of inland transport equipment which Western Europe urgently needs from the U. S. Production within the area can take care of most other requirements.

Import requirements initially were set by the European Committee at 103,000 cars, with 89,000 needed in 1948-49. European equipment is less than half the size of ours; so in terms of U. S. freight cars this boiled down to about 20,000 cars in 1948 and 19,000 in 1949.

Freight cars, of course, are one product whose need in the United States is urgent. Car builders have more than 100,000 cars now on order. Thus far their deliveries have failed to average more than 6,000 cars a month.

The President's Committee on Foreign Aid, surveying the tough situation here and in Germany, finally recommended a shipment in 1948 of 20,000 cars (the American equivalent is 8,000). To the extent this is met, American railroads will have to accept somewhat later delivery. The number involved is not great enough, however, to make any appreciable difference in the overall freight situation. This is likely to remain about as tight in 1948 as it has been this year.

ELECTRICAL EQUIPMENT

Equipment for Europe's electrical industry may prove less troublesome than originally expected. Western Europe plans to produce all the heavy apparatus required for its vast generating plant expansion — at least for the first several years. Thereafter, U. S. producers will be in a position to help them if they need it.

The four year need for U. S. equipment originally was set at $500 million. Some $300 million of this is to be spent on items that do not include any heavy apparatus. Materials and equipment required by the electrical manufacturers themselves are on this list, although no details are given. Its exact effect on our own electrical industry can not be measured until we know more specifically what is involved.

The remaining $200 million will go for hydro equipment on projects of an international character. These may possibly be financed by the World Bank and an immediate start on the equipment is probably not necessary. U. S. electrical equipment producers certainly could not get such work well under way for several years. But certain shipbuilding firms might begin on turbine equipment if desired.

If the electric equipment story ended at this point, it wouldn't be so bad. However, the above figures don't give the full picture. Large motors, turbo generators, and other items are also required for expansion in the petroleum, coal, and steel industries. In many cases these very products have held up the completion of new capacity in this country. Even without Europe's demand they would continue tight well into 1949.

MACHINE TOOLS AND OTHER MACHINERY

Western Europe hasn't set any fixed estimate of what it might spend on machine tools, construction machinery, and other equipment. If the entire program went as initially planned, about $550 million would be available in 1948 for such products. However, the amount actually spent will probably be considerably less than this. No direct aid is likely to be given by the U. S. for the purchase of such equipment; so the countries concerned will have to use whatever funds they can scratch up themselves. How much this will be no one knows.

Machine tools are certain to bulk large on this list. Shipments to Western Europe in first-half 1947 were at an annual rate of $75 million. They should be in larger volume next year. Western Europe appears to hold a fairly adequate stock of general purpose tools. But the expansion of capacity in a number of metal working lines, if carried through, will require a large variety of special purpose tools.

Machine tool needs can be met without difficulty. However, one group of products that might cause trouble is construction equipment. This has been in great demand here. While some items are approaching an easier supply position, others like cranes and power shovels remain very tight. Western Europe has spent a modest sum on U. S. construction equipment — $16 million in the first six months of 1947 — but it would like to spend more. If it tries to do so, exports to Canada and Latin America may have to be cut.

Demand for U. S. textile machinery by Western Europe also has been relatively small — about $7 million in first-half 1947. This situation is expected to continue.

with the region producing most of what it needs itself.

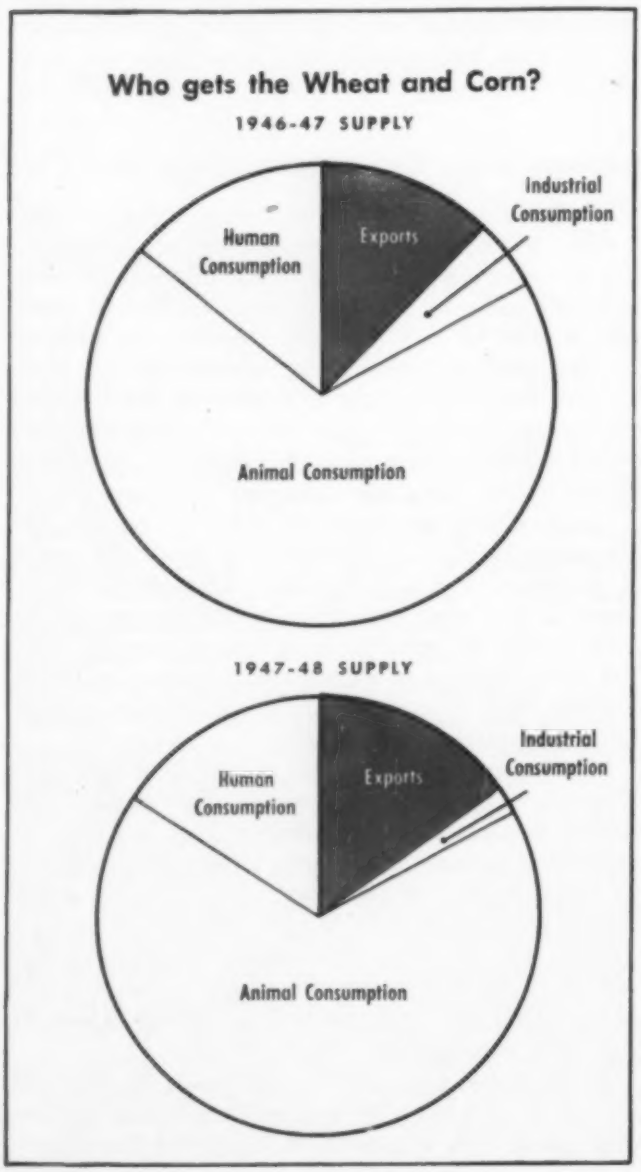
Steam engines, canning machinery, milling machinery, and a long list of other equipment items round out Western Europe's capital requirements. Most of these can be supplied without many of the difficulties reviewed above. And there is one product of great importance to America which Western Europe plans to satisfy largely from its own plants – automotive equipment, particularly passenger cars.

EQUIPMENT FOR THE FARMER

Western Europe's first request for farm equipment in the 1948-51 period was equal to our entire output of 1947. Since this amount obviously can not be spared, the request has been scaled down very substantially. In 1948 shipments are not likely to be more than $100 million, with the new four year goal something on the order of $600 million (half the initial figure).

American farmers can spare this amount of equipment in 1948, although they certainly would buy it themselves if it were not set aside for Europe. Production is likely to run to about $1.35 billion, up some 10% from 1947. But other foreign customers also will have a bid in for a part of this. Canada and Latin America, who bought some $105 million of the $175 million of farm machinery exported this year, need further equipment badly and cannot be shut off with nothing.

After meeting the European and other export demands, American farmers still should receive more new equipment than in any other year except 1947. Thus, they will continue to make considerable progress in their drive to mechanize, although the pace will be slower than they would choose. Above all, the demands of Western Europe and other countries should not be too large to interfere with U. S. food production.



THE FOOD SITUATION

Food may turn out to be one of the chief trouble spots of the Marshall program – particularly for American business. Because of the program, food exports will be larger, domestic consumption somewhat smaller, and prices higher than they otherwise would be. In spite of this, Americans should eat about as well next year as in 1947. However, if prices are bid up in the process, wages and industrial costs may climb with them.

As matters now stand Western Europe would plan to spend about $1 billion on U. S. food in 1948. This is less than they spent in 1947. It also is less than Western Europe feels is necessary to realize the minimum standard of living it set up as a goal for 1948. However, the overall supply of grains – by far the largest commodity on the food list – is down this year by 14%. As a result estimates of Europe's food imports have been reduced.

Here is what went into the record export in the fiscal year 1946-1947. (Figures are thousands of long tons).

	Shipments to Europe 1946-7	Total Exports 1946-7
Wheat and Flour (grain equivalent)	6,638	10,520
Other grains	2,572	4,538
Fats and Oils	156	233
Meat (carcass weight equivalent)	195	224
Dairy Products	322	493
Other Foods	1,266	2,425
Total Foods	11,149	18,433

The President's Committee on Foreign Aid has recommended Europe receive about the same total foodstuffs as last year. However, the product mix will have to be changed. Moreover, the rest of the world will get about a million tons less. Wheat will substitute for corn, but even then the total supply of grains available to Europe will be down 700,000 tons or more. Half of this may be made up with a heavier shipment of fats and oils, including peanuts. Dried milk solids, dried fruits and other products will close the rest of the gap.

There is no doubt the U. S. can send abroad whatever foodstuffs Congress finally agrees upon. The big question is whether this can be done without forcing prices higher. Wheat shipments, for example, may run 40% greater than would normally be exported under current circumstances.

Unfortunately no final answer on food prices is possible. On the supply side much will depend on how next years crops turn out. So far crops are off to a bad start, with winter wheat probably below that of a year ago. As for domestic demand, consumers are likely to have at least as much purchasing power next year as this. The problem is to persuade them to use it on commodities that embody less grain.

When all these considerations are added together it is apparent that food prices over-all do not stand much of a chance to fall markedly in 1948. On the contrary, there is more than a small chance they will rise. Moreover, under the Marshall program exports in 1949-50 would still help support farm and food prices. Any substantial decline could be initiated only by a fall in domestic consumption. Needless to say, these are matters that are important to the business community.

Long Range Problems

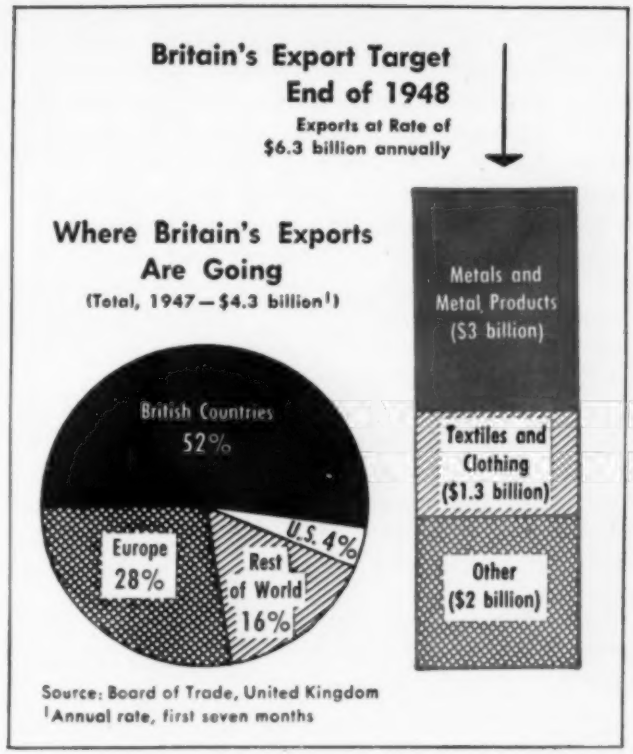
A PROGRAM of the size Western Europe has set for itself inevitably will influence American business over the longer run. New industries are to rise, old ones are to be rebuilt and expanded, exports are to be pushed — all this has a direct bearing on America's foreign markets of tomorrow. Any sound and final judgment concerning the Marshall program, therefore, must weigh certain long run considerations as well as the short.

These longer range considerations are summed up most simply in an assessment of the broad pattern of Europe's future trade. Here a few key trends serve as useful signposts. They are:

a) Industrially Western Europe is preparing to make itself more independent than before the war. This will reduce its imports from the United States. After 1951 export of American manufactures to Europe will be concentrated largely in specialized items which this country has a superior knowledge and skill to produce.

b) Prior to the war Western Europe was primarily an exporter of textiles, industrial products and high quality consumer goods. Industrial revival is along the lines that will push these same products. However, Western Europe's program for expanding industrial capacity points to one significant modification. Capital goods exports — electrical equipment, industrial machinery, finished steel — will bulk much larger than at pre-war.

c) Western Europe's world trade must be considerably larger than in the late thirties. Two developments account for this. First the split in Germany and Europe makes necessary a much larger import of essential foodstuffs and materials from outside the Continent. Second, Europe now must pay for a larger share of its imports with exchange derived from exports. In the Thirties, about one-sixth of Europe's imports represented a return on investments held abroad. While this margin is not eliminated, it has been cut substantially.



d) By far the largest items on Western Europe's import list will be foodstuffs and raw materials. These needs to some extent must govern the location and character of the markets to which it exports. The U. S. must continue to be one such market, for Europe will need our wheat.

A survey of Western Europe's import needs in 1951 shows that Britain and Western Germany are the two countries to whom world trade will be of decisive importance. Other countries will trade as they always have. However, their ability to feed themselves to a large extent lessens their trade burden and makes possible the concentration of much of it within Western Europe itself. It is Britain and Germany, therefore, that are likely to become America's heaviest competitors.

Britain has the world's greatest food deficit. Moreover, its factories are largely engaged in converting the raw materials of other countries into finished goods. Britain therefore must export or die, and that is more true today than ever. The British now have set an export goal that would boost shipments to 175% of their pre-war volume. Later they may pare this. Nevertheless, an export volume at least half again that of pre-war will be necessary for Britain to restore its living standard.

Some clues to what and where Britain will export are available in its current trade pattern (see chart). A close study of this pattern leads to one broad conclusion. The British are concentrating on the export of the same general lines which the U.S. will push. Machinery, automobiles, iron and steel products, electrical goods — these are items that even today stand high on the export lists of both Britain and the United States. Britain in particular must turn to durable goods of this character to replace smaller coal and textile exports.

Prior to the war Britain sought to direct exports primarily to two areas – her empire and Western Europe. Except for foodstuffs from Argentina, British imports from South America were small. This situation has not changed, and there is good reason to believe Britain will seek to maintain it. As the chart shows, about half Britain's postwar exports have been allocated to the Empire, and another quarter to Europe.

Other than in Canada, U. S. firms find it hard to get into this Empire trade. Empire countries have large sterling balances and lack dollars. It is not surprising, then, that they use dollars chiefly for goods Britain can not itself deliver. Such a situation may well last.

The German position is somewhat different, but not radically. Today Western Germany's population of 48 million is almost a fourth greater than in the late thirties. Yet the region can produce little more than half the food it requires. Unlike Britain it must start from scratch in order to develop export markets so as to pay for its food.

Coal will be one money maker for Germany, but it won't earn exchange in all places from which Germany must buy. A likely development is the resumption of shipments of those metal products and chemicals which the Ruhr can produce efficiently and in quantity. Iron and steel products, machinery, chemicals and possibly electrical equipment might be expected to flow from German plants for sale on other continents.

South America, with its food and raw materials, is a natural target for German trade. Such an exchange grew rapidly in the twenties, only to fall victim to the great depression. By the late thirties it was again on the road to revival. The third great push for German-Latin American trade is expected in the fifties.

THE FAR EAST

With Britain enlarging its trade to the Empire and Germany coming into other markets, U. S. traders certainly will feel a competitive pressure that is not present today. How tight that pressure is may hinge on developments in yet another region – the Far East.

The Far East is a vast agricultural and raw material area that has hardly moved to the threshold of industrialization. Yet it has great centers that lend themselves to industrial growth. If political stability were to be established in the Far East, the way would open to a trade greatly benefitting both Europe and the United States, as well as the Far East itself. A surplus of rubber, tin, cotton, wood fibers, and even foodstuffs might then be produced and exchanged for the industrial products of the West.

The Far East, then, is one of the big unknowns in the foreign trade equation of the next decade. Another unknown is the reestablishment of trade between the East and West of Europe. Western Europe's plans count on such trade, and it makes good economic sense. But no one can say for sure that economic sense will prevail in this instance.

These unknowns make any final judgment about the long range success of the Marshall program impossible. This much is certain, however. Without the restoration of East-West trade in Europe, a large expansion of Far East trade becomes an absolute essential. In the absence of both, Western Europe cannot possibly achieve stability by 1952.

Pros and Cons

ANY BALANCE SHEET set up by the business man on the Marshall program will carry a number of items on the liability side. Some of the main entries are these:

The program will be costly – perhaps as much as $15 billion. Through their tax bills business men will bear a good share themselves.

At least for 1948 a number of troublesome bottlenecks will be sustained and even magnified. As a result some producers won't realize the expansion they plan.

The high cost of living, the peg on which many labor troubles hang, will move down very little, if at all, and it may move up.

In helping Europe to reequip itself, American industry is arming a potential competitor. Moreover, the arms it offers are of the most up-to-date variety.

There is no guarantee the program will succeed; as a matter of fact certain conditions essential to its success make it look like a risky bet indeed.

Obviously none of these shortcomings can be taken lightly. Against them, however, can be placed some very weighty items on the asset side.

First, and very important, is the simple but humane consideration that without U. S. aid people in a number of Western European countries will be placed in dire straits. At best they will lack adequate food for a healthy life. At worst they will starve.

The economic situation in Western Europe has a profound political and military meaning for the U. S. This is a matter of direct interest to the businessman. If Western Europe ever loses its political independence to another foreign power, the ultimate cost to America will make the expense of the Marshall Plan look like a mere pittance.

Finally, the Marshall program offers the only hope of realizing some measure of economic stability in a world that today appears permanently upset. In this regard the program can do no harm, but only good. Even if it falls short of its stated objectives, Western Europe will have taken a long stride forward.

The assets outbalance the liabilities.

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complete line of valves PROCESS INDUSTRIES

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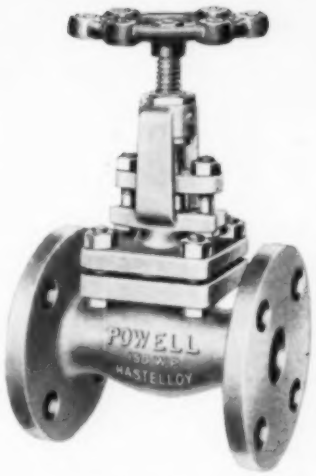
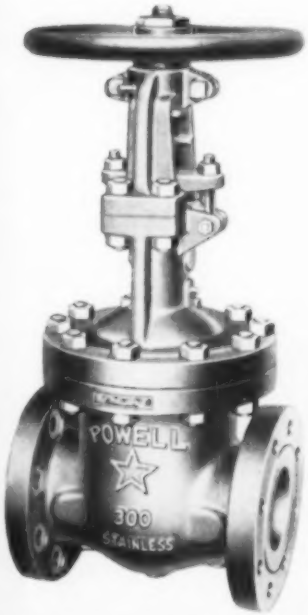
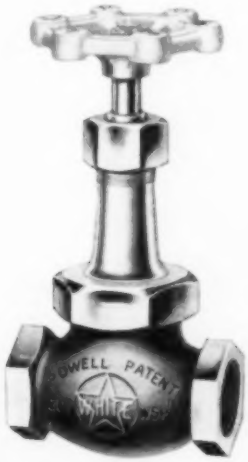
As of today, the Powell Line includes Bronze and Iron Valves of all required types, designs and sizes; Cast Steel Valves of all types in pressure classes from 150 to 2500 pounds; and Valves for Corrosion Resistance, available in the widest range of metals and alloys ever used in making valves.



150-pound Hastelloyt O. S. & Y. Globe Valve.



Class 300-pound Stainless Steel O. S. & Y. Gate Valve.



200-pound Bronze Globe valve with renewable stainless steel seat and regrindable, renewable "Powellium" nickel-bronze disc.

Stainless Steel Angle Relief Valve with enclosed spring.

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Monel Metal*
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Molybdenum

*Registered trade-names of the International Nickel Co., Inc.

†A registered trade-name of the Haynes-Stellite Co.

VALVES

WATCHING WASHINGTON

R. P. McBride, EDITORIAL CONSULTANT
Donald O. Loomis, WASHINGTON CORRESPONDENT

AEC sets up regulations to control exports of equipment used in nuclear work . . . Rubber Reserve will try low temperature synthesis in production of GR-S . . . Domestic synthetic rubber demand fluctuations harass Rubber Reserve . . . Army may grant 20-yr. leases on three synthetic ammonia plants in South . . . I.G. nylon patents made available by Justice Department . . . Harriman Report estimates chemical needs of Marshall Plan countries for 1948 as $260 million . . . ITO conference in Havana turns attention to world trade problems.

AEC Export Regulations

EXPORT of most technical equipment connected with atomic energy work has been simplified by issuance of definite Atomic Energy Commission regulations. Until now, export of almost any equipment with an atomic angle has run into a blockade. Exporters had to get a Commerce Department license. The Department referred anything with an atomic look to AEC. And in the absence of definite regulations, rejection was almost automatic.

The new regulations list certain specific kinds of equipment which are subject to restriction. Equipment not listed is in the clear, so far as AEC is concerned. Most rigidly restricted are machines capable of production of uranium 235 or plutonium. This includes, of course, nuclear piles and isotope separation equipment, most of which it is already illegal for anyone except AEC to own. But it also includes accelerators of positive particles (such as cyclotrons and linear accelerators) with a power of more than a million electron-volts. These are known as items of Class I equipment in the new regulations.

A specific AEC license is required for manufacture, ownership, or export of any Class I equipment. Present owners must obtain a license. Class II equipment which is more significant to industry, is limited to specific listed material and is more loosely controlled. Here, a license is required for export or for manufacture known to be for export. However, manufacture for ultimate incorporation in an exported item does not require a specific license.

Class II equipment consists of radiation detectors and their parts. In addition to highly specialized components this includes microammeters sensitive to less than 1 micromicroamp; high-gain high-impedance linear pulse amplifiers; electrometer type tubes with grid inputs of less than 1 micromicroamp; resistors of more than a thousand megohms.

Also included are mass spectrometers and parts; vacuum diffusion pumps with inlet jet diameters of 12 in. or more; and Van de Graaff and similar machines capable of more than 100,000-v. potential differences.

Equipment exports normal in chemical engineering work will not be interfered with by the new order. A few classes of equipment convenient for atomic projects but also useful elsewhere may require a license for shipment out of United States. But such licenses seem certain to be granted for proper foreign projects having interest for American enterprise.

Low Temperature Synthesis

RUBBER executives of the government have long been unhappy that GR-S did not afford greater resistance to cutting, tearing, and tire-tread wear under heavy duty conditions. Pilot plant results obtained by Rubber Reserve apparently point the way to correction of this condition.

Beginning in January, Rubber Reserve is going to operate at Baton Rouge, La., one of its GR-S production lines under radically new conditions. Temperature of polymerization will be much lowered. To avoid great slow-down in production, a new copolymer formula will be used. There will be a change in the hydrocarbon percentages, a modification of catalyst, and the introduction of new techniques. This first commercial operation will undertake to utilize the pilot plant experience as a start. But substantial changes in formulation and operation are likely to develop, as the commercial reaction batch is about ten times that of the pilot plant.

Results obtained early next year undoubtedly will be applied in all GR-S plants as soon as optimum methods and conditions can be established. The result, it is expected, will be an improvement of a quarter or a third in the life of rubber products made from the newly developed copolymer. This change will radically affect the competitive relation between synthetic and natural rubber. Even more radical changes are under investigation. In other words, the government rubber-making program is far from static.

Rubber Reserve Worries

RUBBER RESERVE had a terrible time in anticipating United States demand for synthetic rubber which it produces. Last summer it shut down a considerable part of the government-owned facilities, as demand for the output was declining rapidly. The decline was the result of the ability of industry to get larger supplies of natural rubber.

About the time readjustment of production rates had been perfected by Rubber Reserve, the price of natural rubber jumped by more than 50 percent. Interest of rubber products makers in the natural supply declined correspondingly. Reopening of government butadiene producing units became necessary on a substantial scale. Thus, Rubber Reserve incurred large expense for shutting down and a second large expense for a reopening which could not have been anticipated under the trends prevailing a few months earlier.

These circumstances led to an in-

What lining for greatest protection? Lowest cost?

On your next lined-tank installation — put it up to Stoneware. Send us your sketches or prints, tell us what solutions you plan to use, their concentration, what impurities are developed, operating temperatures and margin of safety required. In turn we'll suggest materials that will prove most effective, for the longest period of time, at the lowest cost.

"U. S." Engineers are not wedded to any one material. Whether we recommend our Tygon plastic sheeting linings, Tygoflex dip lining, Paraply rubber linings, USSCO acid Brick or Tile, Resilon asphaltic resinous linings, Republic sheet or homogeneously bonded lead linings, phenolic or Duralon hard coatings, the suggestion is made with one question in mind:

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sistent demand that a new sales policy be established to prevent recurrence of the more serious effects of abrupt changes in demand. Hence, a new rubber policy has been under debate and is to be applied next year.

Rubber Allocations

REQUESTS for synthetic rubber are currently in excess of 40,000 long tons per month, whereas Rubber Reserve can manufacture currently only about 33,000 tons. Some system of allocation had to be worked out to place the available supply where it would do the most good. No rigid formula has been adopted, but in general the plan is about as follows:

Those who use rubber for "transportation," primarily tires, must employ at least one-half as much synthetic as natural rubber. Applications of all 28 tire makers for this usage, being mandatory under the law, must be met first. If there were any other mandatory uses, they would be treated likewise. From this point on, optional allocation begins. And the demand is often more than twice the supply for these purposes.

Certain kinds of usage get a bit of priority at this point. Small quantities are allocated for development of new products. Occasionally quantities are allocated to certain companies who have proven new products but not yet established market acceptance. Rubber Reserve thinks both these development efforts deserve support, in order that the long-time good of synthetic rubber and the rubber industry be promoted.

Forward Orders Required

A MAJOR trouble of synthetic rubber produced by the government has come from inability to anticipate demand far enough ahead to provide changes in plant activity. Most of that trouble is expected to disappear, as all synthetic rubber purchasers now must place their orders three months in advance. For example, all the needs for March 1948 should have been ordered on or before December 12.

These advance orders are accepted by Rubber Reserve up to ability to meet them in the form of enforceable contracts. Purchasers who do not take deliveries when ready will not get much consideration during later periods of shortage.

It was thought that a penalty in the price charged would be provided for fluctuations from the orders so entered under contract. But the policing of a price program seemed too serious to be acceptable in administrative headquarters. Enforcing the simpler plan of orders 90 days in advance was therefore fixed.

In a few cases Rubber Reserve knows that government synthetic is resold. If that is done only occasionally as a matter of emergency, it offers no serious objection. But the government does not sell to brokers and will not continue to allocate rubber to those who do not buy it for their own usage only.

Long-Term Leases

ARMY officials will take advantage of the authority given by Congress last summer to make long-term leases of certain chemical plants. These are establishments which the Army wishes to keep for military reserve (therefore not surplus) but which it does not need in current operation. First works to be so considered are three arsenals making synthetic ammonia.

The plan contemplates a 20-year lease which will permit established chemical enterprise to enlarge and utilize these arsenals fully with retirement of the new capital within the long-lease period. Previously the maximum lease was for five years, which was not enough for design, erection, and operation sufficient to pay off new capital.

The Army will require that it have first call on the ammonia made at the three arsenals, Cactus in Texas, West Henderson in Kentucky, and the Heyden operated Morgantown plant in West Virginia. It will expect companies leasing these facilities to complete the plants for making nitric acid and grained ammonium nitrate. Contracts will include the usual national security clause, which arranges for reversion to government control in case of military emergency. Other details of the contracts remain to be negotiated.

Less Tax Exemption

INDUSTRY which meets tax-free competition of cooperatives has been arguing before the Ways and Means Committee that such arrangements should be modified in the new tax law. One specific plan is proposed for changing the present difficult situation. It deserves more attention than it has received, probably because most people have not understood the present basis for exemption.

True exemption from taxation is granted only to bona fide agricultural producer organizations. It is required that not less than 50 percent of business done must be with members. Also it is required that not more than 15 percent of those for whom business is done may be non-members or non-producers.

Purpose of these limitations is to make the co-op a servant of agricultural producers either for marketing or purchasing. The producer is one who actually runs a farm, either in person or by arrangement with employes or tenants. Such folks are thus favored by the law by being exempt from any taxes on profits. The theory is that the agricultural population is to be aided in what is commonly called "unfavorable economic relationships" with the rest of business.

Specific proposals that seem to have some chance of getting Congressional approval are that the percentages above referred to be modified. It looks as though Congress might ask that at least 70 (or possibly 80 percent) of the business be done with members, and that not more than 10 percent non-members, non-producers be participants. Such a tightening up of the law sounds possible. It would not be so much subject to the charge from co-op sources that the rest of business is trying to destroy co-ops.

Ammonia Plant Offered

SOME synthetic ammonia facilities installed at Missouri Ordnance Works have been declared surplus and are offered for sale. This plant as a whole has been transferred to Bureau of Mines for use as its main station in the manufacture of synthetic liquid fuels. But conversion of all of the synthesis facilities from ammonia to fuel processing is not required. Hence, two lines of the original installation are available. Would-be purchasers should consult the chemical division of War Assets Administration.

Sale of Chlorate Plant

A PLANT installed during the war to make potassium perchlorate is being pressed for sale by War Assets Administration. This works was built by Cardox Corp. at Claremore, Okla., to produce 200 tons per month. Construction was completed, but full-scale production was never achieved. Equipment is included for making the intermediate product, sodium chlorate.

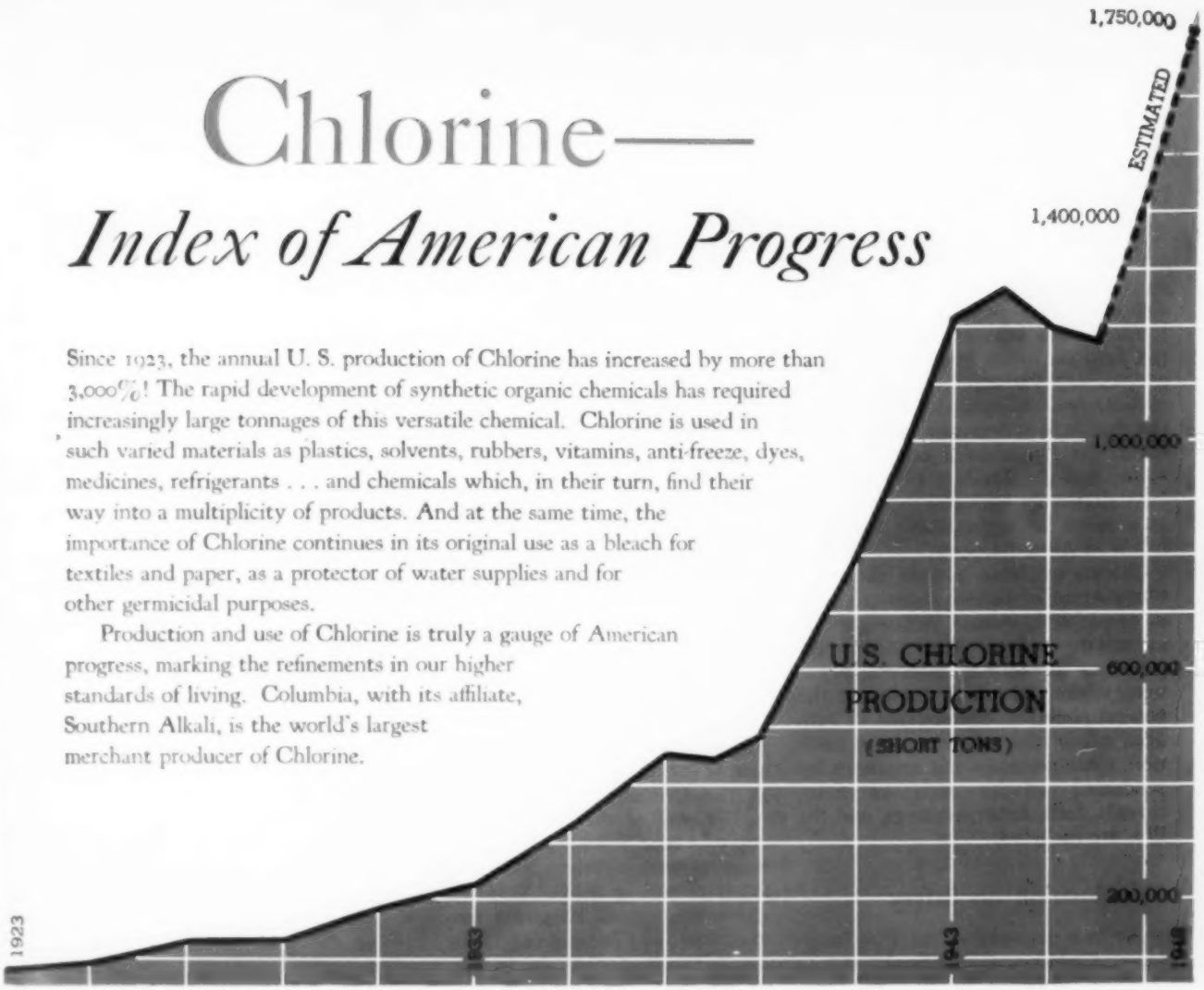
The original total government investment was of the order of a million dollars, but approximately half of that was for platinum electrodes. The property without electrodes has been valued by J. G. White Engineering Corp. as having a present estimated fair value of $273,500, of which the land, land

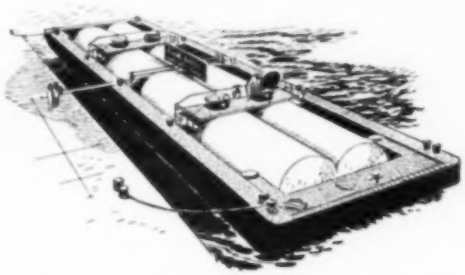
Chlorine—

Index of American Progress

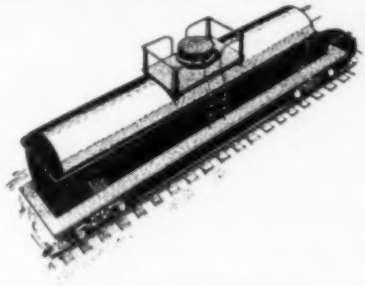
Since 1923, the annual U. S. production of Chlorine has increased by more than 3,000%! The rapid development of synthetic organic chemicals has required increasingly large tonnages of this versatile chemical. Chlorine is used in such varied materials as plastics, solvents, rubbers, vitamins, anti-freeze, dyes, medicines, refrigerants . . . and chemicals which, in their turn, find their way into a multiplicity of products. And at the same time, the importance of Chlorine continues in its original use as a bleach for textiles and paper, as a protector of water supplies and for other germicidal purposes.

Production and use of Chlorine is truly a gauge of American progress, marking the refinements in our higher standards of living. Columbia, with its affiliate, Southern Alkali, is the world's largest merchant producer of Chlorine.





NEW COLUMBIA BARGES offer numerous advantages to large-volume chlorine consumers located along the Ohio-Mississippi waterways. Each barge has a capacity of 600 tons and has many features for safety and simplicity in loading and delivery.



55-TON CHLORINE TANK CARS were first placed in service through Columbia assistance in design. Complete transportation service includes 30-ton single unit tank cars . . . multiple 15 one-ton unit cars and 100 and 150 lb. all-steel cylinders.

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improvements, buildings, and structures are $178,600. Thus the "fair value" of production facilities is less than $95,000.

Nylon Patents Open

A NOMINAL fee will be charged to any American firm desiring to license on a royalty-free, non-exclusive basis, any of the 46 patents dealing with I. G. Farben methods applicable in the field of nylon making. Prior to government seizure, the patents were exclusively cross-licensed between I. G. and the DuPont company. In releasing them, the Department of Justice explains that the DuPont company has "withdrawn its exclusive license . . . as a result of negotiations with the Office of Alien Property."

Patents available include those for manufacture of various chemicals such as adipic acid, oximes, lactams, useful in making nylon. Also covered are processes for making synthetic linear superpolyamides which constitute the general chemical composition of artificial silk of the nylon type. In addition, some processes and apparatus for producing articles such as films, threads, foils, tubes, coatings, and the like, are included.

Coordination on Safety

AT THE REQUEST of the Fire Insurance Conference, Federal Works Agency Administrator P. B. Fleming named a special committee to advise regarding ammonium nitrate safety. The five members of that group have organized and reviewed pertinent material. At the instigation of the chemical members of the committee, it has been decided that no publicity will be given to the findings of this group until after they have been coordinated with the general government Inter-Agency Committee. Thus the projects of Federal Works Agency will, it is expected, be kept constructively in harmony with the larger government program.

Many Tariff Cuts

SIGNING of a large number of modified and a few new trade agreements was accomplished in Washington and in other world capitals about the first of November. As a result, the American tariff law has been effectively amended by a very large number of new cuts in duty or agreements to freeze free-list items.

An interesting side light on this development came when the question arose as to who would announce the new agreements. Final decision was that all should be announced together through United Nations. The purpose was to make promptly available to American enterprise those agreements in which the United States was not a party but which would apply to American trade. A very large number of the bilateral agreements in which Uncle Sam is not a signatory are made without discrimination among the various nations. Thus, the United States policy is becoming almost worldwide through eliminating single nation trade duties not available to other friendly countries.

Scientific Listening Post

A MARKED departure in diplomatic representation of the United States government in foreign capitals was announced last month. A mission on science and technology is to be established at the American embassy in London. Its job is to facilitate the exchange of scientific information and personnel between the U. S. and the United Kingdom. Its first chief is Dr. Earl A. Evans, Jr., professor and chairman of the department of biochemistry at the University of Chicago.

The staff of the London group at any one time will total 12. Four will be permanent members whose primary interests will be in the fields of biochemistry, organic chemistry, physical chemistry, and engineering. Four "rotating" members will be in the field of medicine, and four in non-medical biology including agriculture.

While its primary function is to serve the U. S. government, it's expected that the group will be in close contact with the National Academy of Sciences. Also, the Office of Technical Services of the Department of Commerce will serve as a channel through which private organizations in the U. S. may contact the London group.

European Aid Hits Hard

CONGRESS and the chemical industry will be debating for many weeks the Administration's proposals for economic aid to Europe, as embodied in the so-called Harriman Report. These proposals represent a screening and scaling down of the quantities of equipment and raw materials the Western European countries said they'd need between now and 1951.

The Harriman Report's proposals have far-reaching implications for the operation of the chemical process industries. Here are the most significant:

Chemicals—As such, chemical industry gets quick treatment mainly because requirements of chemicals weren't specified by the Marshall Plan countries. The report estimates that the CEEC (Committee for European Economic Cooperation) countries' chemical requirements for 1948 would be about $260 million—compared with a total U. S. production of $9 billion.

At the same time, it notes that although European demands would be small, quantitatively speaking, nevertheless these demands would affect U. S. chemical consumers—since domestic demand for nearly all chemicals is at or above capacity. What the report suggests is that European chemical demands be handled commodity-by-commodity and country-by-country as the specific need arises.

For specific products, the report analyzes the effects of increased exports to Europe as follows:

Soda ash and caustic soda: U. S. plant expansion of 27 percent and 45 percent, respectively, is forecast for 1952 over 1947. "Industry rationing and drying up of black market would provide additional supplies for Europe. Increase in European coal production must be achieved."

Carbon black: Would require plant expansion in U. S. to increase exports, but British and French rubber manufacturers are not held back by lack of carbon black. Industry re-allocations in the U. S. would increase amount available for export.

Coal tar crudes and intermediates, coal tar dyes, phenol, benzol and glycerine: Increase in European coal production is key to these problems.

Nicotine and arsenical insecticides: Increased exports would be at expense of domestic users. Harriman group recommends use of organic chemical substitutes.

Fertilizer—Nitrogen fertilizer exports must be speeded up so that full IEFC allocation to Europe is shipped by the end of January. Authority to allocate nitrogen for export, which expires at the end of February, must be extended through the 1948-49 fertilizer year. Phosphate and potash pose no problem; Europe can be supplied from other sources.

The committee recommends that "top priority should be given to the provision of steel and equipment to repair war-damaged nitrogen fertilizer plants (in Europe) as rapidly as possible, and to the allocation of adequate supplies of coal to operate them to capacity." The report notes that most CEEC countries are using their entire nitrogen capacity, part of which had previously been unutilized for lack of coal. Further increases in production

As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Cost cut $1315 with SPEEDAIRE

THIS installation demonstrates the remarkable capacity of Speedaire. It drives a large paste mixer filled with water, into which bags of dry paste are dumped one at a time. Mixing each batch takes 8 to 10 hours steady running.

A conventional water-cooled worm gear drive large enough to do this job would have cost $1315 more money, or more than twice as much. Furthermore, a standard unit would have added nearly two tons of weight and occupied almost three times the space.

Speedaire is Cleveland's new fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—will deliver up to *double the horsepower* of standard worm units of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore —giving you the advantage of a compact right-angle drive. Speedaire gives the same long, trouble-free service characteristic of all Clevelands.

For full description, send for Catalog 300. The Cleveland Worm & Gear Co., 3273 East 80th Street, Cleveland 4, O.

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CLEVELAND
Worm Gear
Speed Reducers

should come from repairs and expansion of plant facilities.

U. S. exports of nitrogen should be increased considerably above the current level by utilizing to full capacity the synthetic nitrogen plants owned by the government. While not much can be done about exports for the 1947-48 fertilizer year, the following should be done to increase 1948-49 exports: Hold domestic consumption of nitrogen fertilizer to the 1947-48 level; install equipment at Ordnance ammonia plants at Etter, Tex., Henderson, Ky., and Morgantown, W. Va., to permit production of finished ammonium nitrate fertilizer; through government or private initiative, get into production two ammonia units at Louisiana, Mo., Ordnance Works and the uncompleted unit at Etter, Tex.

German Scientists

THE WHOLE question of bringing German scientists to the U. S. for work in private industry and private laboratories has been reviewed again by the military and government agencies. This time the State Department which heretofore has not granted visas for permanent entry of such men, appears to have been won over. State agreed to approve visas for a limited number of scientists now in Germany whose services have been requested by U. S. organizations.

I. G. Farben Patents

PATENTS once owned by I. G. Farben belong to the government, according to the latest decision in a court case being fought between Standard Oil Co. of New Jersey and the Department of Justice. Under the ruling of a Circuit Court of Appeals, the federal government is entitled to patents covering production of synthetic rubber, soap, toluol, asphalt paving and hydrogen, while other patents relating to the processing of oil and gasoline go to Standard Oil Co., N. J.

Agricultural Research

LOOKING forward to the day when this country will again produce more grain than it can dispose of, the Department of Agriculture has begun a long-range research program to discover new ways to make grain and grain-products useful in the chemical and manufacturing industries.

Possibility of using huge volumes of alcohol from grain as an automotive fuel will be studied in a project which will examine the injection of water-alcohol mixtures in internal combustion engines. The results will be compared with the efficiency of alcohol-gasoline mixtures.

The work will be carried out at the Northern Regional Research Laboratory, Peoria, Ill., by the Bureau of Agricultural and Industrial Chemistry.

Basic Magnesium Prospects

WAR ASSETS ADMINISTRATION is satisfied it has lined up power contracts to take care of present and future lessees at the Basic Magnesium plant, Henderson, Nev., at least until 1951.

These "interim" contracts, when signed, will guarantee adequate power for lessees, although the price of the power under these short-term contracts is higher than WAA thinks future companies will have to pay under permanent power contracts after 1951.

State of Nevada has been offered the town of Henderson, plant and all, and would like to take it. The state has priority, and would have the advantage of a price based on "fair value," which may run in the neighborhood of $35-40 million. (Plant originally cost $140 million.) If Nevada buys the town and plant, it can bring in power from Boulder Dam, at low cost.

The difficulty is that in order to get its allocation of Boulder power, Nevada has to guarantee to pay for it and this can't be risked unless Nevada knows for sure it has the power consumers in the Basic Magnesium plant to foot the bill.

Meantime, WAA is checking over its list of a dozen or so chemical companies it hopes to pull into Henderson in addition to those already there. Some of the prospective tenants have been holding back until the interim power contracts have been lined up on a more definite basis.

What Havana's About

IT'S hard to get behind the headlines and the torrent of words flowing from Havana to find out what the ITO conference, now meeting there, is all about. Briefly, here are some of the questions to be settled, questions which will have repercussions on the process industries' ability to export and their possible competition from imports into the U. S. market:

Will industrially underdeveloped countries have to get prior approval from the ITO before imposing quotas on imports? Quotas are banned in principle. The exception allowed for economically underdeveloped countries is one of the many exceptions to ITO general principles designed to clear the way for expansion of world trade.

Another question about a country's imposition of import quotas has been decided favorably for the U. S. position. As the ITO charter now reads, a country in balance-of-payment difficulties has to get prior approval of the International Monetary Fund before it imposes the import quotas to protect its balance of payments position. And the U. S. swings the most weight in the Monetary Fund.

The situation outlined has made the question of voting power in the ITO itself less important. The U. S. delegation now prefers a voting system weighted according to population and world trade.

Subsidies vs. Import Quotas

ON THE question of the use of export subsidies, the U. S. position hasn't yet been incorporated in the ITO charter. Hence there's work to be done on this point. Present provisions restrict the use of "export" subsidies, which the U. S. has used on farm products, for instance, but puts no restriction on the use of "domestic" subsidies, used by many foreign countries. This is unequal treatment of an equal situation and the U. S. wants these provisions to apply equally to all countries, regardless of what form they take.

Wartime German Science

YEAR-LONG writing job of a group of German scientists reviewing wartime German scientific research has been completed and published. It was organized by the French, British and American governments through their FIAT (Field Intelligence Agency, Technical) organization. The complete work totals 42 titles in 84 volumes as follows: 10 titles in chemistry, 10 in physics, 15 in medicine, 4 in earth sciences, 2 in mathematics and 1 in biology.

Purpose of the huge task was to get from leading German scientists themselves a review of research in their own specialized fields which was not published or otherwise made available during the war. The reports are in German, with French and English forewords. The first two volumes received in this country by the Office of Technical Services run to about 150 pages each.

Approximately 100 sets of the complete report will be deposited in as many libraries throughout the country. Copies are in possession of the research agencies of the armed services.

CHEMICAL ENGINEERING
with CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 DECEMBER 1947 SIDNEY D. KIRKPATRICK, Editor

Taking the Measure of the Marshall Plan

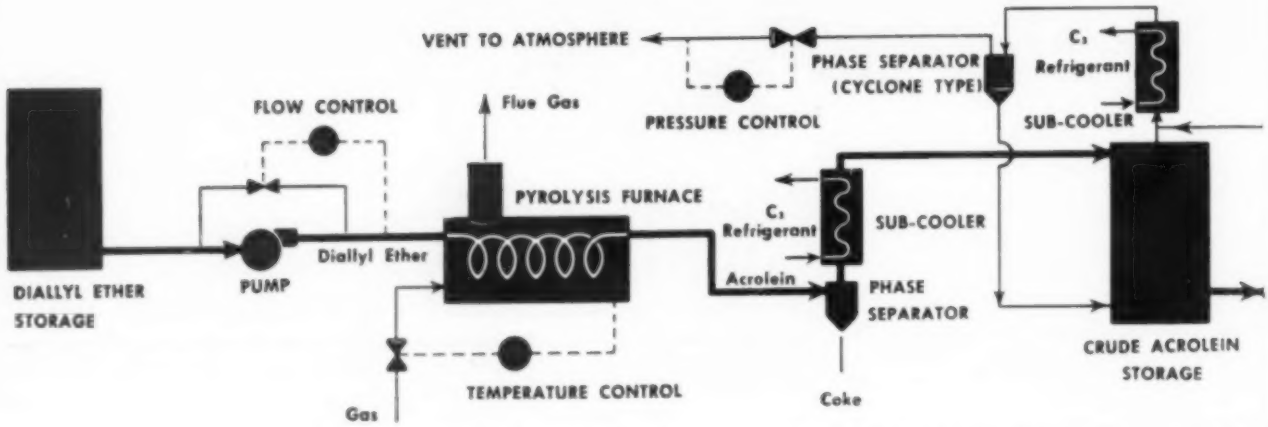
SCIENCE and technology share in responsibility for world affairs and in turn are affected by them. Hence it is our obligation as chemical engineers to help where we can in appraising the social and political significance as well as the technical and economic implications of our work. Such an opportunity is now presented by the Marshall program, with its immediate and long-range impact on nearly every phase of our existence.

One keenly aware of this obligation is Dr. C. E. K. Mees, who addressed the recent annual meeting of the American Institute of Chemical Engineers in Detroit. Even though the political arena is distasteful and unsuitable for the average scientist or technologist, Dr. Mees holds that the scientific method can and must be used for the study of the structure of society and its reaction to changing conditions. He did not mean to imply that these social changes can be measured and controlled with the same techniques used in the physical and natural sciences. But he did remind his engineering audience that "the scientist is not only a scientist; he is also a citizen; he must perform his duties as a citizen. If he cannot yet apply his scientific principles to his political actions, those actions, nevertheless, need not be arbitrary." They can and should be based on long established and tested principles of truth and justice, of factual rather than conjectural reasoning, of logic instead of emotion.

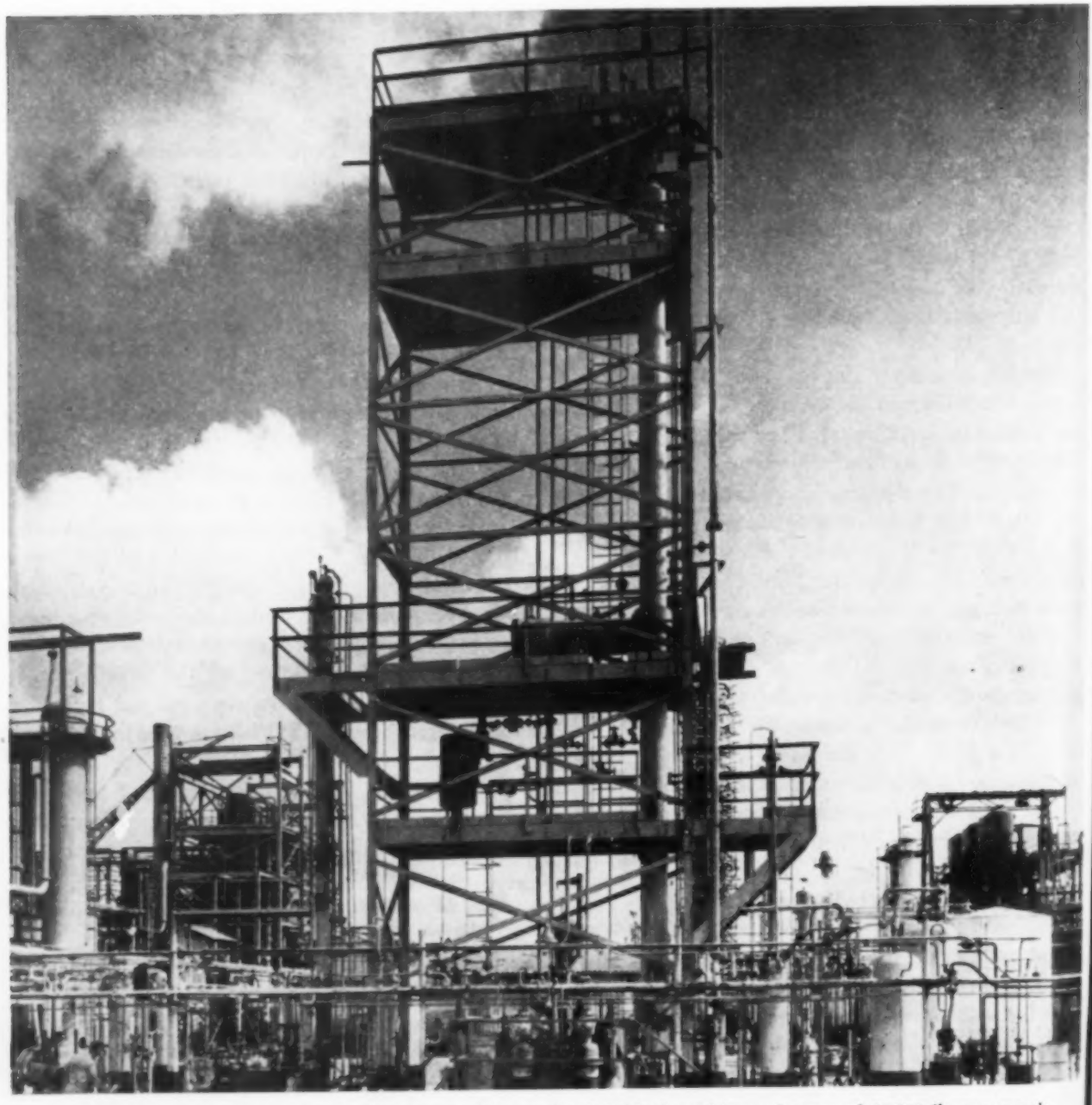
Perhaps the most constructive contribution any of us can make in the present crisis is to insist that such proposals as the Marshall plan be studied and discussed apart from all appeals to emotion and to the prejudices of sectional and selfish interests. This is not an easy assignment, to be sure, but it is exactly what has been attempted by the McGraw-Hill Department of Economics in the report that features this issue of *Chemical Engineering*. The sole purpose has been to determine the likely effect of the program on American business, having in mind the long-range as well as the immediate problems involved. Even though the ultimate decisions for or against the Marshall plan will probably be made by the Congress as a political issue, it is hoped that this purely factual approach will help clarify the phases that affect most American business and industry.

The Marshall plan is neither an engineering blueprint nor a detailed flowsheet leading directly to a product or objective. Rather it is an over-all map of the terrain to be covered, an inventory of present needs as well as of latent skills and resources required to work out its ultimate solution. It impinges heavily on the process industries and the chemical engineering profession. It will accentuate and sharpen our shortages, slow up capital expansion by bidding for equipment components, engineering know-how and services. It will force our farmers to share the fertilizers more urgently needed abroad. Its costs will not be limited to the direct outlay of $17 billions over the next four years. We face indirect liabilties in the hazard of increased living and production costs as wages and prices are bid up in the process of supplying preferential needs abroad. Nor can we lose sight of the fact that we are building modern and efficient plants for potential competitors in countries that must depend on foreign trade for their markets.

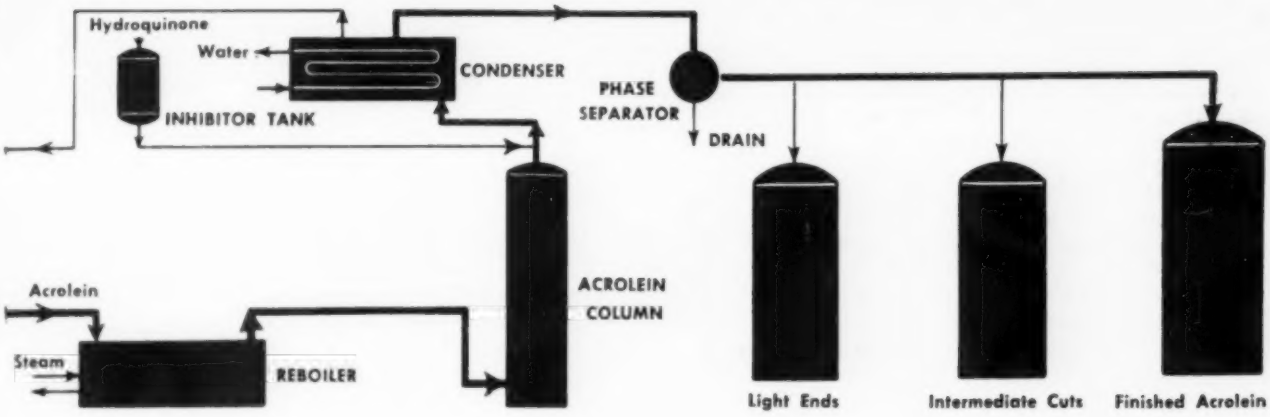
Yet for all these heavy liabilities and costs, there are offsetting assets in the lasting benefits that can come from a peaceful, prosperous world. The war taught us that no task is too big or difficult to yield to the organized industrial might of America. We must apply methods of the same sort and magnitude to the problems of peace.



Shell overcomes difficulties in production of acrolein, versatile intermediate. Process involves thermal cracking



From this compact plant comes the first commercially produced finished acrolein at the rate of 20,000 lb. per month



of diallyl ether, byproduct in manufacture of allyl alcohol, followed by distillation of the crude product formed

Shell Succeeds in Producing ACROLEIN

F. G. WATSON
Department Manager, Shell Chemical Corp., Houston, Tex.

PROCESS TRANSFERS LIQUIDS BY NATURAL GAS PRESSURE RATHER THAN BY PUMPS AND OTHER SPECIAL TECHNIQUES

Although acrolein is an extremely reactive and versatile chemical building block its extensive use has, heretofore, been restricted by the primitive methods available for its preparation. Acrolein was first made, on a laboratory scale, over one hundred years ago by the dehydration of glycerin with magnesium sulphate. Since that time there has been considerable interest in this compound, as indicated by numerous references in the literature. However, since the glycerin process, due to high cost of starting materials and poor yield, prohibited production of acrolein in industrial quantity, development of the potentialities of this bifunctional compound has been long delayed. Until recently no other economically feasible process had been developed.

With the installation by Shell Chemical Corp. at its plant at Houston, Tex., of a commercial unit for the manufacture of purified acrolein, limitations to development of its diversified uses have been removed. The process involves the thermal cracking of diallyl ether, produced as a byproduct in the manufacture of allyl alcohol, followed by the distillation of the crude product formed to produce a refined acrolein of 96 to 98 percent purity. The first commercial production of this chemical was started in response to demands from several manufacturers of resins, insecticides, pharmaceuticals and chemical intermediates.

The process used for the manufacture of acrolein was evolved by Shell Development Co. at its laboratories in Emeryville, Calif. Due to the necessity for speed in both development and semi-commercial production, a pilot plant was constructed at Houston and began operation in October 1945. By early 1946 it was seen that this unit, which reached its capacity at 3,000 lb. per month on a 24-hr. day basis, was inadequate to meet the growing requirements of consumers.

For a hundred years chemists and engineers have been trying to devise methods for the commercial production of acrolein, an extremely reactive and versatile chemical building block. At last the problem has been solved. Shell Chemical Corp. has developed the method and has a plant in operation at Houston, Tex. The special handling technique of this hazardous chemical and other features of the unique process are described by Mr. Watson.

Therefore, to replace the pilot plant, the semi-commercial unit presently in operation was constructed. This increased capacity of finished product to 20,000 lb. per month. Increase in plant capacity has kept step with developments in end uses. The latter are now, in most cases, in the semi-commercial stage. It is expected that further increases in production capacity will be required as consumers of this material swing into full commercial manufacture of their products.

Pyrolysis Step

The chemical reactions involved in the pyrolysis step are illustrated by the following equations:

$$\underset{\text{Diallyl Ether}}{CH_2CHCH_2OCH_2CHCH_2} \rightarrow \underset{\text{Acrolein}}{CH_2CHCHO} + \underset{\text{Propylene}}{CH_3CHCH_2}$$

$$\underset{\text{Diallyl Ether}}{CH_2CHCH_2OCH_2CHCH_2} \rightarrow 6C + 4H_2 + H_2O$$

$$\underset{\text{Acrolein}}{CH_2CHCHO} + H_2 \rightarrow \underset{\text{Propionaldehyde}}{CH_3CH_2CHO}$$

The first equation represents the main desired reaction. The conversion, which is exothermic, is carried out by non-catalytic pyrolysis at 30 psi.ga. and 970 deg. F. Under these conditions approximately 90 percent of the diallyl ether is consumed and acrolein to the extent of 86 mol percent of the ether converted is found in the pyrolysis product. Also formed at this temperature are carbon, hydrogen, water and propionaldehyde as shown by the second and third equations, as well as about 5 mol percent (based on ether converted) heavy ends.

Properties of Acrolein

Acrolein, an unsaturated aldehyde, is a volatile liquid boiling at 126 deg. F. It is clear and colorless in appearance. The odor is pungent and the vapors have a strong lachrymatory effect and are extremely irritating to the nose and throat. Fortunately, concentrations producing permanent toxic effects are well above the tolerable limits, mild exposures causing only brief discomfort to any one who comes in contact with them.

After purification by distillation, acrolein is subject to polymerization. Thermal polymers form as a result of storage for extended periods at temperatures above atmospheric, while contact with air causes oxidation polymers. The formation of either type appears to be stimulated by light while the latter may be inhibited by the use of hydroquinone. Shipments of the refined product contain 0.2 percent weight of this material to deter polymerization.

The hazardous nature of acrolein and its tendency to polymerize were taken into consideration in the plant design. All equipment to handle materials containing acrolein is designed for the transfer of these materials by natural gas pressure rather than by pumps, to minimize sources of leakage and the attendant fume problems. For similar reasons distillation reflux is obtained through the use of the liquid head from elevated condensers. To exclude air, storage vessels are blanketed with natural gas. Consequently, all vessels and process equipment are designed for 150 psi.ga. working pressure, are provided with natural gas connections for pressuring and purging and are connected to a common vent system. Likewise, relief valves, which are protected by rupture disks to prevent sealing of the valve by polymer, discharge into a common vent line. These vent systems exhaust to a stack which discharges to the atmosphere 60 ft. above ground. To guard against an accumulation of liquid acrolein in the stack base it is sealed by a lute purged by a continuous flow of water. Since no corrosion problems have been encountered at any stage of the process, construction is uniformly of mild carbon steel.

Two Sections

The plant unit may be divided into two sections, the crude acrolein system in which diallyl ether is pyrolyzed, crude acrolein condensed and propylene vented; and the purification system in which the crude product is distilled, stored and loaded for shipment. The former is semi-continuous while the distillation is performed batchwise.

Diallyl ether of 99 percent purity is charged by a pump on automatic flow control at a rate of 0.33 g.p.m. to the pyrolysis furnace. The furnace consists of a horizontal brick-lined cylindrical chamber, gas fired at one end. Heated gases from the burner pass the length of the furnace through a 12-in. pipe concentric with the shell, enter the chamber at the opposite end and return the length of the furnace in the annular space between the central duct and the furnace wall, then exhaust through a stack at the burner end. The pyrolysis tube, 65 ft. total length, consists of 14 passes of 1¼-in. pipe connected in series by return bends. The coil is arranged in the annular space in the furnace chamber. The last pass contains a section of 2-in. pipe in which a thermowell is installed to indicate pyrolysis temperature. Other thermocouple points indicate furnace temperatures.

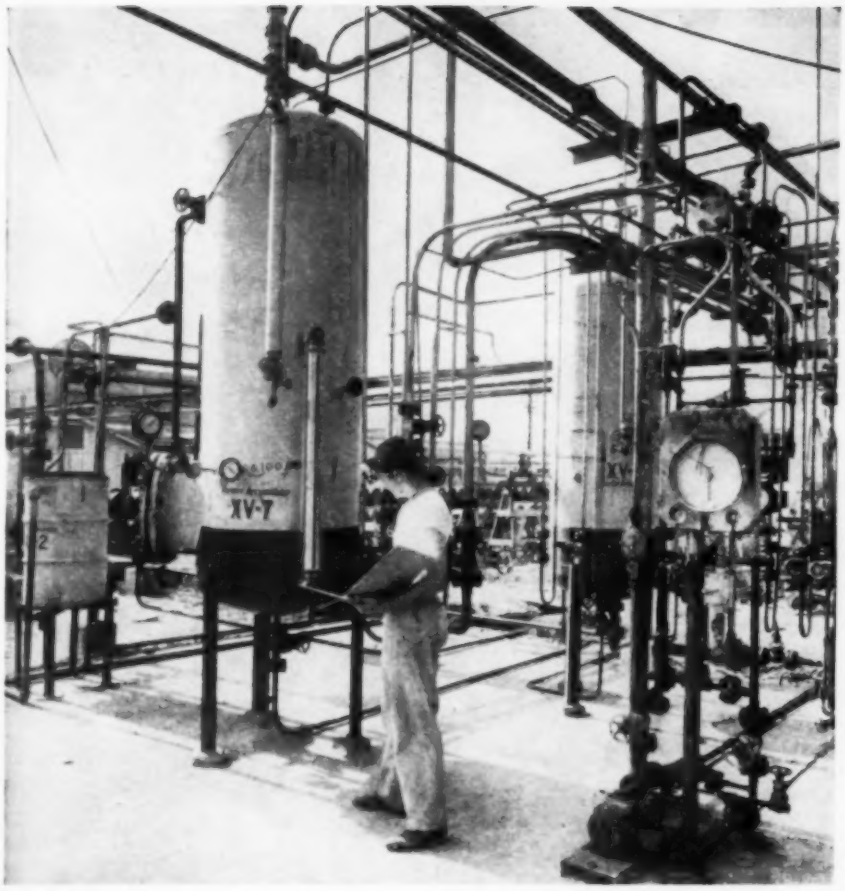
Diallyl Ether Conversion

Liquid diallyl ether charged to the furnace tube is vaporized and converted to acrolein at 30 psi.ga. and 970 deg. F. as detailed above, whence it passes to a cyclone separator provided for the removal of coke, then to a water cooled condenser where the major portion of the product is condensed at 85 deg. F. The stream then enters a 400-gal. crude storage vessel which also serves for the separation of the uncondensed gases and the crude liquid product. These gases, which contain 14 percent acrolein by volume, then pass through a propane refrigerated subcooler which reduces the gas stream temperature to 35 deg. F. and its acrolein content to 4 percent. The liquid acrolein is returned to the crude surge drum through a liquid seal. The propylene stream is then vented to the atmosphere. A back pressure regulator in this stream maintains a pressure of 30 psi.ga. on the entire crude acrolein system. This system is operated under pressure to take advantage of the lower ratio of the partial pressure of acrolein to the partial pressure of propylene in equilibrium at the condensing temperature, thus acrolein loss in the vented stream, is reduced.

Control of the pyrolysis system, because of the critical limits within which pyrolysis temperature must be maintained to attain maximum yield and minimum coke formation, is of greatest importance. The system pressure and the feed rate are automatically controlled while the furnace firing is semi-automatic. Because a portion of the ether fed is reduced to coke even under optimum pyrolysis conditions, furnace run length is limited by its formation. The accumulated carbon is removed by blasting with high pressure steam to remove loose amorphous material and by air burning to remove hard deposits. Average run time is 10 hr.

Acrolein finishing is performed batchwise in a 12-in. diameter column which has a 40-ft. section packed with 1-in. ceramic Berl saddles. The reboiler has a charge capacity of 325 gal. and consists of a horizontal kettle with a steam coil of 50 sq. ft. surface in the lower part.

Too, there is a shell and tube type condenser with cooling water in the tubes and 85 sq. ft. cooling surface. In order that a reflux pump will not be necessary, this condenser is mounted



Furnace accumulator is in center and extractor accumulator on right

above the column to provide the head required for reflux and for the transfer of top product streams to storage. The top product rate is manually controlled and is indicated by a rotameter. The reflux rate is indicated by a rotameter and is determined by the steam rate to the reboiler. The latter is controlled manually and is indicated by an orifice and manometer.

Charging Distillation System

The distillation system is charged by using the crude acrolein system pressure to effect the transfer from the crude accumulator to the batch kettle. First, the propylene dissolved in the crude acrolein is removed in a "degassing" step. By the admission of steam to the reboiler the column pressure is raised to 30 psi.ga.; at which pressure a line to the crude system vent gas subcooler is opened. The column is then returned to pressure control and operates at the furnace system pressure until the propylene is removed. Acrolein condensed from this stream returns to the crude accumulator. Degassing requires approximately one hour. When liquid reflux is established the distillation column is isolated from the crude system, and is cooled to the atmospheric boiling temperature of acrolein. The balance of the distillation is conducted at atmospheric pressure.

After degassing, a light ends fraction is removed. This cut contains the major portion of the propionaldehyde present in the crude, water, and a high concentration of acrolein. Operation is at a top product rate of 0.03 g.p.m. and a reflux rate of 1.8 g.p.m. Even at this high reflux ratio the separation of propionaldehyde and acrolein is difficult due to the closeness of their boiling points (acrolein 126 deg. F.; propionaldehyde 120 deg. F.). The light ends cuts from several batches are accumulated for later redistillation. Acrolein thus recovered is returned to crude acrolein while the light ends concentrate is burned.

Light Ends Removal

Removal of light ends is continued until a top product acrolein assay of 90 percent weight is reached. At the same operating conditions an intermediate cut to 96 percent purity is segregated. The quantity is sufficient for preparation of the hydroquinone inhibitor solution. Any excess over this requirement is returned to crude acrolein. Above 96 percent purity the top product rate is increased to 0.4 g.p.m. and reflux is reduced to 1.4 g.p.m. At these rates finished acrolein is produced and is directed to storage. Minimum acrolein purity is 96 percent weight while the propionaldehyde content is limited to 0.5 percent. The distillation is continued until essentially all the acrolein is removed from the system since a sharp separation between acrolein and unconverted diallyl ether (b.p. 203 deg. F.) is readily obtained. Bottoms from this distillation, containing polymers, other reaction products and some diallyl ether are discarded.

Finishing Column Plugging

A problem which was encountered in the pilot plant but which was remedied in the design of the semi-commercial unit was the plugging of the finishing column packing by acrolein polymers formed during distillation. Using a rotameter to apportion the flow, a 20 percent solution of hydroquinone in acrolein is injected continuously into the vapor line between the column and its condenser on the light ends and finishing steps. The flow is adjusted to provide a hydroquinone concentration of 0.2 percent weight in both the reflux returning to the column and in the product withdrawn to storage. Two small pressure vessels are used alternately for dissolving and supply. Solid, photographic grade hydroquinone is used while intermediate cut acrolein, as described above, is used as the solvent.

Shipping

From storage the refined product is transferred by gas pressure to returnable shipping containers previously cleaned and purged free of air using natural gas. A closed loading system is used to prevent entry of air or escape of fumes. The natural gas displaced is vented to atmosphere via the exhaust stack manifold. Fourteen gage ICC Class 5A drums of 55 gal. (380 lb.) capacity or steel cylinders containing 100 lb. of acrolein are used for shipment of this material. This liquid, which has a vapor pressure slightly higher than that of acetone, is unloaded from the container by the use of an eductor pipe and moderate inert gas pressure.

Thanks are due to E. F. Herrerias, who has aided considerably in the preparation of the data necessary for this article.

Chemical Engineering Award Dinner to
MERCK & CO., INC.
New York, December 3, 1947
SPONSORED BY CHEMICAL ENGINEERING
Drucker-Hilbert Photo

Chemical Engineers Honor Merck & Co.

Approximately a thousand chemical engineers, executives and guests of the profession met at the Waldorf-Astoria in New York City on December 3 to honor Merck & Co. Inc., for its outstanding postwar achievement in the development and large-scale production of the wonder drug, streptomycin. The occasion was the presentation of the Eighth Biennial Award for Chemical Engineering Achievement by Professor-Emeritus Alfred H. White, chairman of the Committee of Award and spokesman on this occasion for the chemical engineering profession. It was received on behalf of Merck & Co., Inc., by its president, Dr. George W. Merck. Excerpts from their addresses follow.

PRESENTATION

ALFRED H. WHITE
Chairman, Committee of Award
Professor-Emeritus of Chemical Engineering
University of Michigan, Ann Arbor, Mich.

As on the occasions of the previous awards, I am deeply conscious of the tremendous and diverse scientific and technological developments which have been achieved by group efforts of chemical engineers in industry. My mind goes back fifty years to the time when, as a young instructor, I took my first class of students on a week's inspection tour of chemical plants. Some of these had a chemical laboratory with one or two analysts, but some of them worked entirely without chemical control. All of them relied heavily on traditional and empirical methods of operation. Inspection trips during the next fifteen years showed a gradual improvement in methods of scientific control.

But the great impetus to scientific development came at the outbreak of the first World War in 1914 when importations of chemical products from Germany were abruptly discontinued. To meet this situation our American manufacturers had to improvise equipment and processes to supply the lacking products. To whom did they turn in this emergency? The men with only tradition as their background were completely at a loss. It was the group of scientists and engineers who came to the rescue. By the end of the first World War chemical engineers had established themselves firmly as a necessary group in any progressive chemical plant. Their importance has grown through years of prosperity and years of depression.

World War II also threw a heavy load on the scientific, engineering and management groups of all our industries. Their magnificent success was due not only to the excellent organization of individual companies but also, in large measure, to the complete cooperation of previously competing organizations who pooled all of their knowledge and resources in a time of national peril. The achievements of the synthetic rubber group and the atomic bomb group were recognized by the Chemical Engineering Awards of 1943 and 1945.

The postwar era has showed no slackening in our industrial developments nor in successful results from the group efforts of chemical engineers. Where there is urgent need for collaboration, competing groups are willing to pool their knowledge, but each company is also working independently according to our famous American competitive system which has made our country the industrial leader of the world. During the war it was heartening to see the large number of plants flying the Army and Navy E flags. If a similar appraisal were possible in this postwar era there would be just as many flags flying, for there has been no letup in efforts or in results.

Our Committee of Award is composed of the chairmen of the departments of chemical engineering in the 51 colleges accredited by the American Institute of Chemical Engineers. These men do not sit in seclusion and pore over musty texts. They are in vital contact with the chemical process industries. They are aware of new developments and are in a position to appraise the relative difficulties and the value of the new achievements. It has been a difficult matter for our committee to single one company out from the many that have made notable advances and deserve high commendation for their skill and their progress, since V-J Day.

The company selected is one with an honorable past, a company which made a very substantial contribution to the war effort. Its rapid postwar development of streptomycin from the test tube to the full plant scale has been a spectacular accomplishment in a relatively new field of chemical engineering. It could have been accomplished only by a fine organization stimulated by progressive management..

Dr. Merck, it is the decision of our committee that your firm—Merck & Co., Inc., has earned the Eighth Biennial Chemical Engineering Award. It is with a great deal of pleasure and hearty congratulations that I now present you with the bronze plaque symbolizing this well-earned award.

ACCEPTANCE OF AWARD

GEORGE W. MERCK
President, Merck & Co., Inc.
Rahway, N. J.

It is significant that this Award for Chemical Engineering Achievement should be made to a member of the medicinal chemical industry, which has brought to the medical profession in the last decade such important, new, life-saving agents as the sulfa-drugs, penicillin and streptomycin.

Before the turn of the 20th Century the manufacture of most medicinal chemicals was still a fine handicraft, involving comparatively simple batch-type equipment. Today the production of streptomycin in our plant requires many buildings connected by a maze of piping and surrounded by

(Continued on page 208)

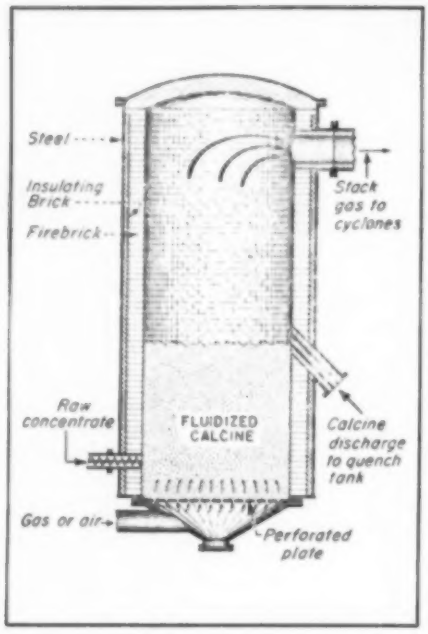


Fig. 1 is adaptation of dense phase fluidization to roasting concentrates

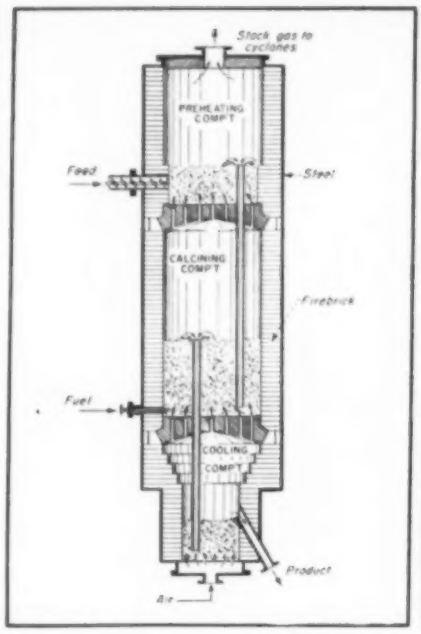


Fig. 2 shows FluoSolids pilot kiln with three superposed fluid beds

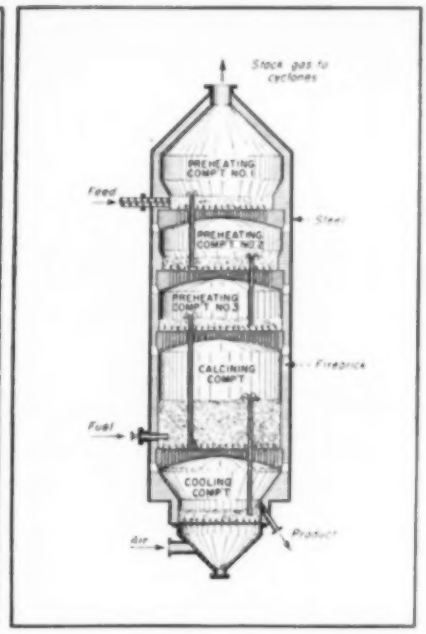


Fig. 3 is type of design which will be used for commercial lime kilns

FLUIDIZATION

FLUIDIZATION, SUCCESSFUL TOOL IN REFINERY PROCESSES, HAS NOW EXPANDED INTO SUCH FIELDS AS LIMESTONE CALCINATION

FLUIDIZATION has in the past few years become firmly established in this country as an important step in various catalytic processes. More recent research and development now have progressed to a stage which definitely indicates the commercial acceptance of fluidization as an important unit operation in many non-catalytic processes, particularly in the chemical and metallurgical fields.

The term, fluidization, is fully descriptive to those who have been engaged in any phase of fluidizing, and to those who have seen the customary demonstration of cold gas fluidizing suitably sized cold solids in a glass tube. However, the definition of fluidization has not yet been stabilized to the degree where it has received universal acceptance and, therefore, we believe it necessary to offer a definition which, at least, attempts to define the dense phase type of fluidization which is most useful in non-catalytic operations.

Therefore, as used in this article, fluidization is the unit operation in which a mass of finely divided solids is maintained, during treatment, in a turbulent dense state by being dispersed in an upwardly moving gas stream which imparts to the mass, a turbulence resembling that of a boiling liquid.

Fluidization, in some form, has been recognized by many and used commercially, for example, in such widely diversified devices as the Fuller-Kinyon pump and the Winkler gas generator. However, the first reduction to practice of fluidization, as defined

Having scored a technological triumph in the petroleum refining industry, fluidization is fast gaining ground at present as an important new unit operation in the field of non-catalytic processes. This development has been strictly hush-hush, with practically no information getting into print. A typical application is limestone calcination. One calcination pilot plant, operating successfully for over a year, has a kiln rated at 11 tons of burned lime per day.

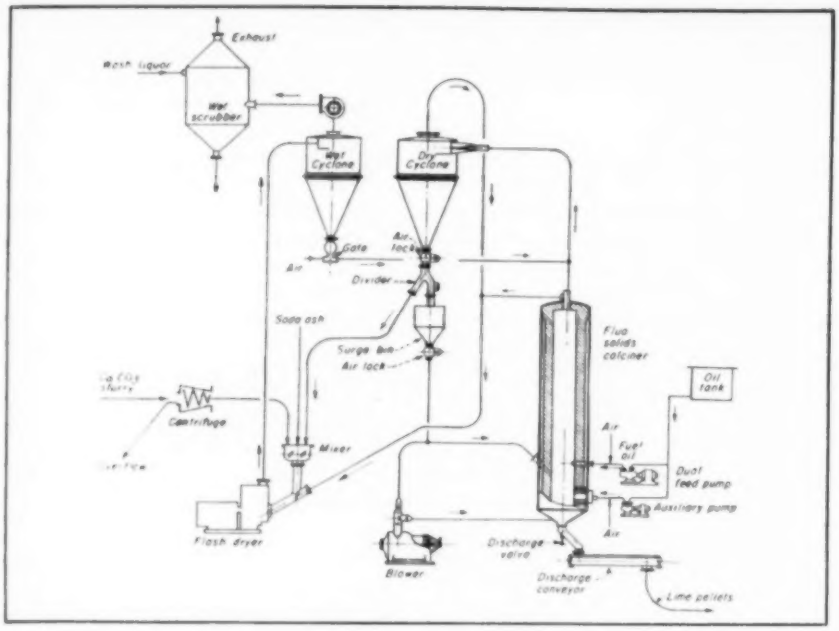


Fig. 4 illustrates flow diagram for lime sludge calcination for use in such industries as sulphate pulp, beet sugar and water softening

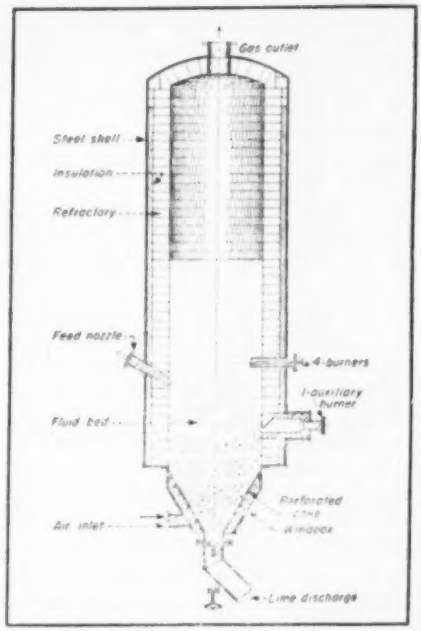


Fig. 5 shows calciner design being developed for lime sludge

In Non-Catalytic Operations

R. P. KITE and E. J. ROBERTS

Assistant Manager of Development Department and Director of Research respectively
The Dorr Co., New York, N. Y.

above, is the work of the Standard Oil Development Co. and its associates.

While dense phase fluidization appears to be the most useful type in the process industries, it is worthwhile to point out some of the important differences, when reduced to practice, in catalytic and non-catalytic fluidized operations.

In catalytic fluidizing operations the solid phase (catalyst) particle size distribution can usually be selected for optimum fluidization. Except for dust losses and make-up, the solids are recycled within the system. If the catalysis is endothermic, the heat can usually be supplied in the form of sensible heat contained in the catalyst and in the gas phase hydrocarbons.

In most non-catalytic operations involving fluidization, the solid phase particle size distribution is dictated by prior or succeeding operations or by economics. Then too, the solids and the gas pass through the system only once and heat or controlled atmosphere must usually be produced within the fluid bed of solids. A factor influencing non-catalytic fluidization is that many operations are conducted at higher temperatures than those encountered in catalytic fluidization. Yet another is that heat economy is involved, requiring use of counter-current heat transfer, preferably in fluid beds. The net result of these distinguishing points between catalytic and non-catalytic fluidization is that the design assumes entirely different forms although both involve use of dense fluidized beds of solids.

Before proceeding to point out some specific operations to which fluidization has been applied, it would be best to outline the general advantages and limitations. The most striking advantage is the degree of temperature control and the uniformity of temperature throughout the fluid bed. It is not unusual to have a 25 deg. F. maximum temperature differential between two widely separated points in a fluid bed and even closer control is possible. This point was emphasized by Dr. Warren K. Lewis in his recent address when receiving the Priestley Medal.

Control of Gas Phase

Similarly, the composition of the gas phase is subject to extremely close control and this is obviously important in simple calcination operations and more so in such controlled reductions as that of Fe_2O_3 to Fe_3O_4.

In calcination operations, where fuel can be injected and burned in the fluid bed, the fuel consumption has been found to be one of the principal economic advantages. Since close temperature control and uniformity of temperature are inherent in fluidized

operations, new processing objectives are attainable.

The principal limitation is that there must be no softening or fusion, nor any surface adhesion, because any agglomerates so formed will not be fluidized and will simply collect at the bottom of the fluid bed. Situations have been encountered in which surface adhesion resulted in the entire fluid bed becoming static and immobile.

Another partial limitation concerns the operating rate. At the optimum gas velocity for good fluidization, the operating rate will be 100 percent of designed capacity. The minimum gas velocity to support minimum fluidization might be 75 percent of designed capacity and similarly the maximum gas velocity might correspond to 125 percent of designed capacity. Therefore, as a generalization, operating rate would be restricted within these limits.

Operations of such general character as the following can be carried out advantageously by fluidization: (1) Calcination of materials such as limestone, dolomite, magnesite, metal hydrates and certain pigments; (2) partial calcination such as that employed in reducing the magnesium carbonate of dolomite to the oxide with only slight alteration of the calcium carbonate; (3) oxidation, particularly when it can be accomplished with air at elevated temperature; (4) reduction of metallic oxides such as the reduction of hematite to magnetite; (5) roasting of arseno-pyrites and sulphides of zinc, copper and iron; (6) chlorination, including volatilization of metallic chlorides; (7) sulphatization such as the conversion of copper oxide to copper sulphate; and (8) heat transfer operations wherein sensible heat is transferred from solid to gas phase or the reverse.

Other Operations

These merely illustrate some types of operations responsive to fluidization. There are undoubtedly many other specific operations not mentioned. Many of these specific operations are now being reduced to practice, some being developed to the pilot stage and still others about to be piloted.

In order to show some of the various forms of reactors and to illustrate some specific results from the use of the technique of fluidization, the following operations have been selected for more detailed treatment: (1) Roasting an arseno-pyrite gold ore; (2) calcination of crystalline high calcium limestone; and (3) calcination of a calcium carbonate "sludge" resulting from the lime softening of the water supply for a midwestern city.

In various parts of the world, for example, Canada and the Philippine Islands, some gold ores contain the precious metal in finely divided form imbedded in arseno-pyrite or pyrite. The conventional winning of the metal by cyanide extraction is therefore impossible, until either arsenic or sulphur, or both, are removed by oxidation, thus exposing the gold to the solvent cyanide solution.

The ore as mined is ground to a suitable fineness for concentration and recovery of the gold values by froth flotation. In most mills it is necessary to grind to 200 mesh in order to free the sulphide mineral from the gangue. Therefore, the flotation concentrate is the product to be roasted and 75 to 90 percent of it may be under 200 mesh, with a normal particle size distribution down through the micron ranges. One particular flotation concentrate of this type has the following approximate analysis: gold, 5 oz. per ton; arsenic, 9.0 percent; and sulphur, 18.0 percent.

Roasting Concentrate

In a few words, the roasting of this concentrate simply consists in supplying it with sufficient oxygen to oxidize and volatilize the arsenic and sulphur, and simultaneously to produce a calcine amenable to cyanidation. Due to the remote location of most mines, arsenic and sulphur recovery is not economical.

Fig. 1 illustrates the adaptation of dense phase fluidization to the roasting of arseno-pyrite concentrates. A somewhat similar construction would be used for roasting other sulphide concentrates. Concentrates are fed to the fluid bed at a rate comparable to the air supply used for fluidization. It is important that these two factors be controlled with respect to each other, to insure maximum capacity and a calcine amenable to cyanidation. Such control is inherent in roasting by fluidization.

Another important control is temperature of the fluid bed. Concentrates of the analysis previously given will, under self-roasting fluidized conditions, stabilize at a temperature of the order of 1,700 deg. F. In some instances it may be determined that a depressed temperature under 1,700 deg. F. will produce a better calcine. This can be obtained in a fluid bed by injecting the proper amount of water. This will depress the temperature of the entire bed to the desired point. Again, this is simply taking advantage of the extreme turbulence and high rate of heat transfer inherent in dense phase fluidizing operations.

The calcine carried out of the Fluo-Solids, or FS, roaster by the stack gases is finished material insofar as roasting is concerned and, therefore, the dust recovered by the cyclones in Fig. 1 joins the main calcine product in the quench tank and is transferred to the cyanidation section for gold extraction. A roaster of this type has been operating in Canada on a scale of 10-15 tons per day since February 1947.

Calcination of Limestone

Application of fluidization to limestone calcination is extremely interesting because of three basic problems involved. First, it was required to calcine completely a crystalline stone, producing a high-grade chemical and plaster lime of good color. Second, the fuel available was Bunker C fuel oil which for the first time, insofar as known, was to be burned in a fluidized bed without discoloring the final white product. Third, heat recovery from both the lime product and stack gas was necessary, requiring heat transfer fluid beds in addition to the calcining fluid bed.

This project was initiated by The Dorr Co. in 1944, on limestone furnished by the New England Lime Co. Conducted at The Dorr Co.'s Westport mill, extensive work on single-compartment reactors, 4-in. in diameter, developed lime samples found to be satisfactory to the lime company. This work also produced the pilot plant design information. Both companies thereafter collaborated in the design and operation of a 5-ft. diameter, three-compartment pilot FS kiln with a rated capacity of 11 tons of burned lime per day. The pilot kiln was operated almost continuously from July 1946 to June 1947, with some anticipated troubles which never materialized and some unanticipated difficulties which did materialize. At the present time a 100-ton-per-day kiln is being designed for New England Lime Co.'s plant at Adams, Mass.

The pilot kiln is illustrated in Fig. 2, with three superposed fluid beds: the top bed receives the limestone (crushed and sized to −6, +65 mesh) for preheating to about 1,100 deg. F. Preheated stone is transferred in the fluidized state down the transfer tube to the central calcining compartment.

usually operated in the 1,700-1,750 deg. F. range. Again, due to displacement of incoming material, the now burned lime transfers down to the bottom compartment where it cools as it preheats the incoming combustion air. The temperature in this bottom compartment stabilizes in the 500-550 deg. F. range and the lime is discharged at this temperature. Gas phase flow is countercurrent throughout, and the cross-section of each compartment is designed to maintain the optimum space rate under the conditions prevailing in each compartment.

Location of the fuel oil injectors is indicated in Fig. 2. Each injector, in rotation, is supplied by positive displacement pump with a definite volume of fuel oil. Since all combustion air, in controlled volume, enters through the bottom and, after preheating, goes into the calcining compartment where the air contacts the fuel in controlled amount, the conditions for combustion proved to be entirely sound and combustion was found to be efficient.

The concept of combustion of unatomized liquid fuel under such conditions will probably be a subject for investigation in the future. It seems obvious that this method of firing would only be successful in a completely fluidized mass of solids, wherein the instantaneous heat release is immediately dissipated throughout the fluid bed. It is believed that some portion of the combustion takes place on the surface of the fluidized particles, but whatever the exact mechanism, the combustion is rapid and efficient. Two supporting bits of evidence are that the lime is not discolored with residual hydrocarbon products and that, under proper operating conditions, there is no evidence of afterburning in the freeboard space above the calcining fluid bed.

Operating temperatures of 1,700-1,750 deg. F. in the calcining bed produce a lime with less than 1 percent CO_2 content and with chemical availabilities of 98 percent of the maximum possible. Of itself this is unusual, but those experienced in lime-burning know that the type of limestone used and the location of thermocouples are factors to be considered. All temperatures reported here were recorded from thermocouples located in the fluidized beds and therefore should closely approximate the actual temperature of the fluidized mass. There was no evidence of "hot spots" which might have been in view of the thermocouples to produce a false temperature reading.

Fuel consumption in the pilot furnace averaged 43 gal. of Bunker C oil per ton of burned lime. Other operating conditions investigated, particularly calcination at the extremely low temperature of 1,600 deg. F., resulted in a fuel consumption of slightly less than 40 gal. per ton. It should be kept in mind that these fuel consumptions were obtained in the FS pilot kiln which has only two heat recovery compartments.

Fig. 3 illustrates the type of design which will be used in the commercial kiln rated at 100 tons of lime per day. All design requirements indicated by operation of the pilot kiln are incorporated in the commercial kiln. Two additional heat recovery compartments are added. Still more compartments would yield additional heat recovery but the design as indicated appears to be the optimum, all factors considered. Obviously, the ratio of fuel consumption to output will be reduced below that reported for the pilot plant, but this and other features of the commercial units will be reported later after operations have stabilized.

Lime Sludge Calcination

Several widely different industries produce a byproduct precipitated calcium carbonate which must be recalcined to lime for either economic or disposal reasons. These industries are (1) sulphate pulp, (2) beet sugar and (3) water softening. In the last case, the precipitate is usually, but not always, a mixture of calcium carbonate and magnesium hydroxide. Following lime precipitation, the suspended solids are removed by sedimentation and further dewatered on vacuum filters or continuous centrifuges. The latter alone is used if both calcium and magnesium are present, because of its ability to remove and discard most of the magnesium hydroxide, leaving a relatively pure calcium carbonate for recalcination and re-use. Filter cake is then dried in a Raymond flash dryer and calcined in the kiln as indicated in Fig. 4. The FS kiln design which is being developed for this particular operation is indicated in more detail in Fig. 5.

In this case, the solids being fluidized are usually finer than 50 microns with a fairly uniform particle size distribution. The gas velocity (expressed as "space rate," the gas velocity in the free cross-section above the fluid bed, and measured at the operating temperature) for dense phase fluidization of material of this type is relatively low, being approximately 0.5 ft. per sec. Since oxygen input is a direct measure of capacity, it was obvious that conventional fluidization would be applicable but with low capacity. Another operating objection to calcining such fine material is that the burned lime produced would constitute a dust nuisance and health hazard. Furthermore, it would be extremely difficult to handle in storage and conventional feeders.

Calcined Lime Pellets

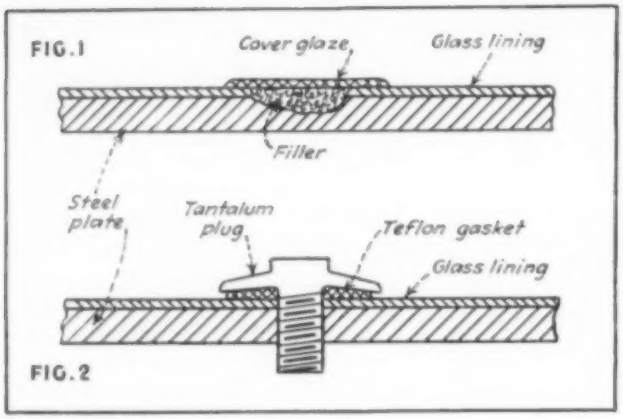
These objections were overcome by the discovery that the addition of a small amount of some such alkali as soda ash, in conjunction with the rolling turbulence of the fluid bed, formed the calcined lime into hard round pellets of about pea size. These pellets are formed and the lime is calcined at a temperature not exceeding 1,850 deg. F. and therefore the product would not be considered to be a hard-burned lime. However, the indications are that it is a well burned lime as measured by the usual "activity" and available lime analyses, taking into consideration the character of the raw material.

In the installation shown in Fig. 5 the predried calcium carbonate is introduced at a controlled rate into the fluidized calcining bed. Fuel is injected, but not atomized, into the fluid bed at a slightly lower elevation and, insofar as is known, the calcination and pelletization occur simultaneously.

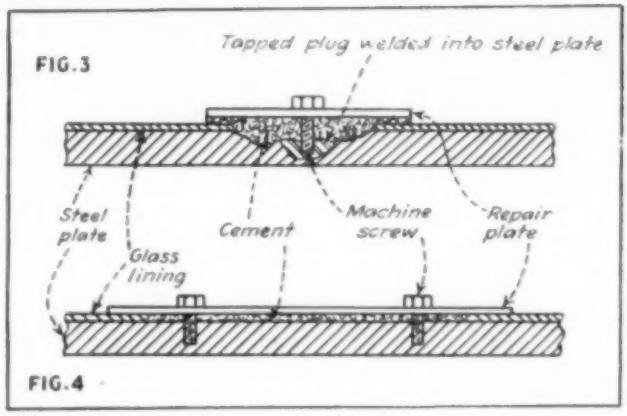
Above the interface of the fluid bed is a freeboard space to permit any "spurts" of dust and pellets to return to the bed. Products of combustion, including a relatively low dust loading, exit at about 1,850 deg. F. to provide the heat requirements of the Raymond dryer.

Although extensive development in small FS reactors has been completed, there are certain problems which can only be solved in the 6-ton-per-day pilot plant, of this type, which will be placed in operation in a few months.

Other commercial non-catalytic applications of the technique of fluidizing are under development at the Westport Laboratories of The Dorr Co. and it is expected that these can be reported as completed. This company is licensed under appropriate patents and patent applications of the Standard Oil Development Co. The material used in the preparation of this paper is a product of the cooperative effort of our many associates in The Dorr Co. and the collaborating organizations.



SMALL BREAKS up to ¼-in. dia. can be fixed with one-piece tantalum plugs, up to 1¼-in. with ceramic patch



LARGE BREAKS over 1¼-in. dia. require plate to hold cement. Plates are Hastelloy, silver, tantalum, stainless steel

REPAIRING Glass-Lined

METHODS AND MATERIALS, A LA MONSANTO

Like every construction material, glass-lined equipment has its virtues and its shortcomings. A glass coating is exceptionally corrosion resistant, but it is also breakable. Hoping to mitigate the effect of this shortcoming, and so permit fuller exploitation of the material's virtues, the Monsanto Chemical Co. recently conducted a thorough examination of methods for repairing glass lining in the field. This article presents the recommendations developed by their study.

IN SPITE of the care with which glass-lined equipment is being handled, failures of the coating do occur. Sometimes it fails because of physical damage inflicted by striking the glass-coated surface with a metallic object or by dropping the entire vessel. In most cases, failures brought about by an impact can be easily recognized. A "sunflower" pattern is formed on the glass with small cracks running radially from the point of impact. These radial cracks or lines are frequently so small that they are not visible to the naked eye but can be seen through a three or four magnification reading glass.

The strength of the bond between the glass and the steel shell is not uniform over the entire interior surface of the vessel. Glass under compression provides a good bond; glass under tension bonds very poorly to the steel. Hence, the glass coating over the knuckle of the heads is difficult to injure because in this area the glass is under compression; the glass coating on the short radius of a nozzle, being under tension, has a very poor bond with the steel and must be handled very carefully. The piping leading to nozzles must be aligned very carefully and the bolts drawn up evenly in order to avoid fracturing the glass coating on the short radius of the nozzle. Since the uneven load resulting from misaligned pipe is applied gradually, no sunflower pattern will appear in the fractured area of the short radius of the nozzle.

Another type of failure is known as a "spontaneous rupture." For reasons not always understood, glass sometimes jumps away from the steel to which it has been applied. Usually these jumps take place immediately after the vessel leaves the enameling furnace. Sometimes, however, they occur years later, either while the vessel is in storage or in service. The manufacturers of glass lined equipment recognize this failing and give the customer a guarantee of one year against spontaneous ruptures. These ruptures usually occur over a welded seam or in a part under a severe strain.

A third type of failure is sometimes brought about by permitting acid to drip or collect on the outside of a vessel. Strange as it may seem, a strong acid solution applied to the outside of a vessel may cause the glass to rupture on the inside. Atomic hydrogen generated at the interface is said to be the explanation for this phenomenon. Therefore it is not advisable to clean the jacket of a glass lined vessel with an inhibited acid having a pH value of 3.2 or stronger. Best of all, don't clean the jacket with any kind of acid solutions.

Fractures or failures resulting from thermal shock are not uncommon. The manufacturers tell us that an instantaneous thermal shock of 175 deg. F. can be safely tolerated. Fractures resulting from thermal shock usually are evidenced by the glass jumping away from the steel in large sheets.

Cements

At the John F. Queeny Plant we are using two types of repair cement: ceramic or silica base type and synthetic resin type.

Ceramic cements:—The ceramic cements have been in use for many years and are used chiefly where highly oxidizing conditions prevail. The cement is applied over the fractured area. Acid applied over the patch converts the sodium silicate into silicic acid. The finished patch is somewhat porous and attempts have been made to fill the pores by applying a coat of clear synthetic resin over the surface of the patch.

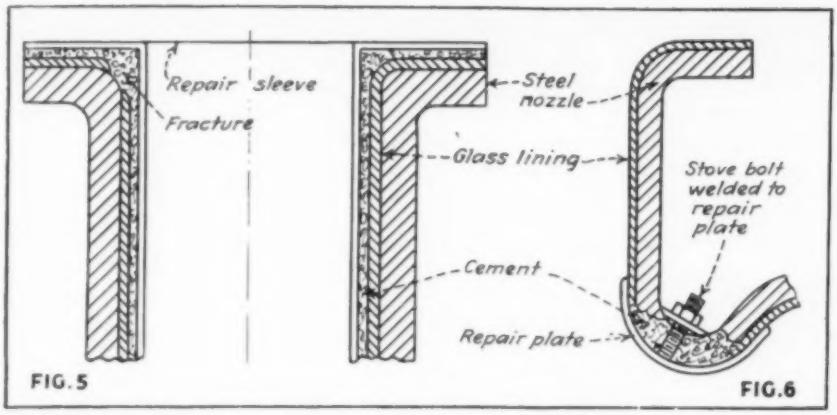


FIG. 5 FIG. 6

CORNER BREAKS Fractures at knuckles and other sharp bends need sleeve or curved plate to hold cement. Sleeves are Hastelloy, silver, tantalum, porcelain

Hand Grinder
Grinding Wheels
Porcelain Dish
Spatula
Camel Hair Brushes
Heat Lamps
Magnifying Glass

TOOLS These—plus plugs, cements, plates—are the special tools of trade

Equipment

E. F. MEIER
Engineering Dept., J. F. Queeny Plant,
Monsanto Chemical Co., St. Louis, Mo.

We feel that the repair cements supplied by the Pfaudler Co. are the most satisfactory and reliable ceramic repair cements available. These repair cements are made in the laboratory, in small batches, under accurate control by trained technicians. The Pfaudler Co. supplies the following ceramic repair cements: AFT-42-black, AFT-42-special white, AFT-42-filler, AFT-42-cover glaze (synthetic resin). More will be said about these products in later paragraphs.

Other repair cements used are: Penchlor, Duro Cement, and Vitrex—produced by Pennsylvania Salt Mfg. Co., Electro Chemical Supply Co., and Atlas Mineral Products Co., respectively.

Some of the above mentioned cements must be suspended in sodium silicate. We recommend the "S" brand sodium silicate of 30 deg. Baume, purchased in sealed containers, quart size or smaller.

Synthetic Resin Cements:—Two different types of synthetic resin cements are in use at the Queeny Plant.

1. Alkor, Carbo-Korez (Atlas Mineral Products Co.) and Carboline (Carboline Co.) are all very similar. They consist of finely divided graphite, catalyst, and plasticizer suspended in a liquid. Carbo-Korez and Carboline are very similar and patches made with these cements can be put into service within twelve hours. Alkor cement is less inert to oxidizing conditions but it will stand up longer under an alkaline condition than Carbo-Korez or Carboline. Approximately 24 to 30 hr. are required before an Alkor patch can be put into service. Carbo-Korez, before using, should be stored at a temperature between 35 and 45 deg. F. The Carboline Co. is prepared to supply its product packaged in sizes convenient for storage and mixing. (Alkor, Carbo-Korez, and Carboline are products very similar to Karbate and are being used for making repairs to Karbate equipment. For all practical purposes, the physical and chemical characteristics of Alkor, Carbo-Korez, Carboline, and Karbate are identical.)

2. Alkaresinous Cement (Nukem Products Co.) is a phenol-formaldehyde resin similar to Bakelite. While this cement is not so inert in organic acids and alcohol, we have successfully used this cement in alkaline service at a temperature of 194 deg. F. at pH 9.

The synthetic resin cements, in common with nearly all synthetic resins, have one failing, namely, a very poor bond with metal. These cements seem to abhor metal and jump away from the surface to which they have been applied. However, in spite of this shortcoming, these cements are being used very successfully, as will be shown later.

Tools

Every repair kit should contain a good hand grinder having a motor designed for continuous duty, light in weight, and well balanced. The Dumore No. 10 hand grinder with Jacob's chuck meets these requirements. An assortment of grinding wheels from ¼ in. to 1 in. diameter having grits running from No. 60 to No. 150 are needed. The coarse grit, No. 60, is well suited for roughening up the glass preparatory to applying the cement patches. A 500 cc. porcelain dish, spatula, camel hair artist brushes, and 300-500 watt heat lamps with built-in reflectors are other accessories frequently needed.

Procedure: Ceramic Patch

It is our opinion that ceramic patches of 1½ in. diameter and larger are not practicable. Patches larger than 1½ in. diameter should be held down with a repair plate made of a suitable metal. Unless the large diameter patches are held down, the edges of the patch will tend to curl up and permit liquid to seep in. It is an axiom with us that the useful life of a patch is inversely proportionate to its diameter, or in other words, the bigger the patch, the shorter its useful life. It is quite true that patches of 6 in. diameter have held up for years; however, such large patches are usually found in a mild acid service and are not exposed to thermal shock.

The following repair procedure is intended for patches not larger than 1½ in. diameter:

1. Clean the exposed metal surface with a hand grinder using a 100-150 grit stone, removing all traces of rust. With a 50-60 grit stone, thoroughly roughen the surface of the glass around the exposed metal; roughen the glass ¼ in. beyond the line where the exposed metal ends. Wash the surface of the metal and glass with alcohol. Dry.

(Over)

2. With a camel hair artist brush apply a coat of Pfaudler AFT-42 cement approximately 1/32 in. thick. Do not puddle or apply the cement as if it were a coat of paint. Daub it on and withdraw the brush, do not attempt to featheredge the cement. Allow to dry for one hour.

3. Apply second coat as described above.

4. Apply third coat as described above.

5. Cover patch with a 50 percent sulphuric acid solution (by vol.). Keep wet for six minutes. Wash with water, dry with clean cloth.

6. Smooth patch by sanding lightly and apply second coat of sulphuric acid as described above.

7. Apply two or three coats of Pfaudler cover glaze, allowing 15 min. to dry between coats.

8. At this point the patch can be heated to a temperature of 150 deg. F. in order to speed up the reaction within the cement.

9. Cure patch for a period of eight to ten hours at a temperature of 150 deg. F.

Ceramic patches have a tendency to develop minute cracks if the application is made in a dry, warm atmosphere. This is especially true if the individual coats are put on too thick. In order to overcome cracking and checking, we apply the coats as thin as possible and humidify the air until we are ready to apply the Pfaudler glaze. Infra-red lamps are an excellent heat source for curing all patches because the rays penetrate the patch and are converted into heat at the interface. Thus the patch is heated from the inside rather than from the outside.

If the steel surface to be patched has been severely attacked so that a crater 1/8 in. or deeper exists, it will be necessary to fill the crater with Pfaudler AFT-42-filler before applying the cement. Proceed as follows: Empty the entire contents of the can into a porcelain dish and mix thoroughly. Put the filler into the crater, filling it nearly flush with the surface of the glass, and press firmly into place with the thumb. Pfaudler filler is a rather dry compound and, for best results, must be pressed firmly into place. Let dry overnight and proceed to apply Pfaudler cement as described under step 2 described above. (See Fig. 1)

Procedure: Plates, Plugs

Synthetic resin cements tend to jump away from any metal surface to which the cements are applied. Ceramic cements tend to curl up around the edges and jump. In order to prevent these cements from jumping and loosening up, we are holding the cements down by means of repair plates. Figs. 2-6 illustrate various applications of hold-down or repair plates. At the present time we are using repair plates made of Hastelloy alloys B and C, tantalum, silver and stainless steel. Some of the patches applied under this procedure have been in service for more than four years without further attention. It is evident that care must be exercised in selecting a cement and a metal repair plate inert to the liquids or gases to which the cement and repair plates are exposed. Fig. 2 illustrates a tantalum repair plug. A similar plug holding down a Teflon gasket has been in continuous service for more than 6,000 hr. resisting aqua regia at a temperature of 176 deg. F.

Fig. 3 shows a badly corroded area in the shell of a jacketed vessel. We feel that in jacketed vessels it is not practicable to drill through the shell and tap the hole for a machine screw. A skilled, careful welding operator using the right procedure can weld a tapped plug into the crater without injuring the glass in the immediate area. The plug should be dressed to fit the contour of the crater. A welding rod of the E-6012 type, known as a "cold" rod, is preferred. By raising the voltage and lowering the amperage on the welding machine, this rod gives fair penetration with a minimum amount of heat. Having filled the jacket with water and running a bead not longer than ¼ in. at a time between cooling, a plug can be welded securely into the crater. By following the procedure described above, it is possible to weld within ½ in. of a glass lined surface without spalling the glass. Fig. 4 shows a repair made to the shell of a vessel by drilling and tapping the steel shell and using bolts made of welding rod. The nuts were made of 10 guage plate.

The short radius on the flange of a nozzle or manhole is always a vulnerable spot and difficult to repair. By cementing a sleeve into the opening (See Fig. 5), this vexing problem can be solved. It is suggested that the piping connection to a repaired nozzle be made before the cement takes a permanent set. Fig. 6 shows a repair made to a fractured surface at a point where the nozzle has been welded into the top head.

The Tantalum plugs shown in Fig. 2 are obtained from the Pfaudler Co. Prices range from $6 up, depending on diameter. The Haynes Stellite Co. carries in stock Hastelloy C and B machine screws and hexagon nuts in a wide selection of sizes. We have found it economical and convenient to make our own nuts out of plate and the bolts out of welding rod. Our repair plates are usually made out of 20 or 16 guage sheet.

An effort should be made to shape the repair plate so as to conform closely to the contour of the area to be repaired.

Clean the exposed metal surface as outlined under Step 1 in a previous paragraph. On larger patches thoroughly roughen the glass around the exposed metal fully ¾ in. beyond the line where the exposed metal ends.

Mix the cement according to the directions found on the container and apply a generous amount to the injured area. Put the repair plate in place and tighten the nuts which hold the plate down. The excess cement should squeeze out uniformly around the edge of the repair plate.

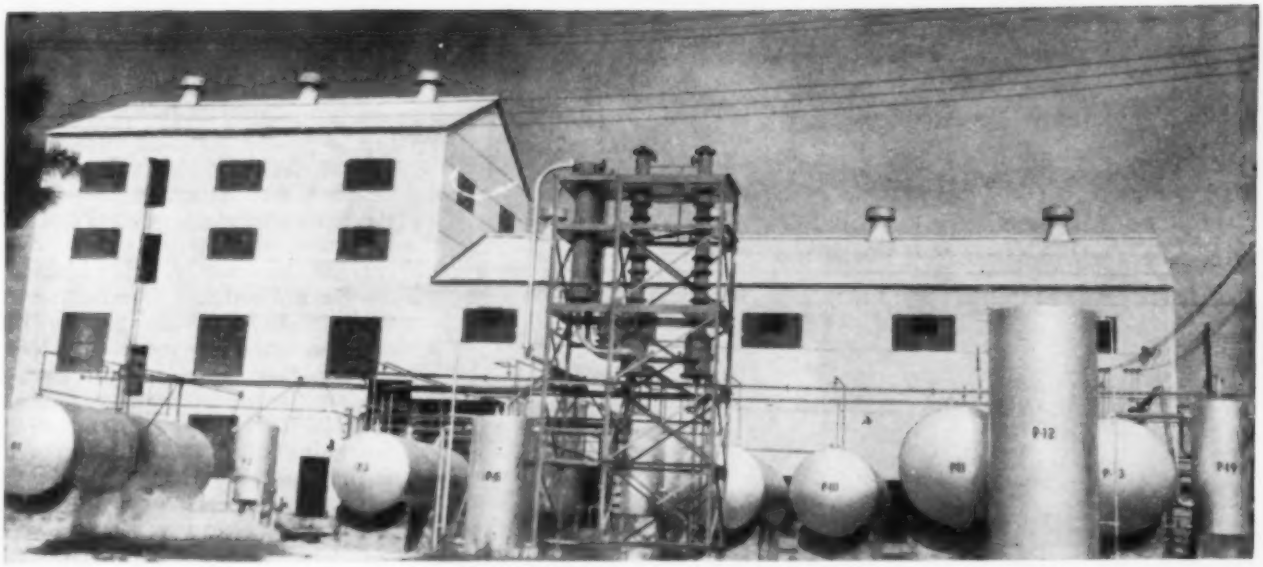
Now apply heat very slowly, using electric heat lamps. During the first four hours the temperature of the patch should not exceed 100 deg. F. Too much heat during the first four hours produces a porous patch. At the end of four hours raise the temperature to 150-160 deg. F. and hold at this temperature as indicated below:

Carbo-Korez, Carboline, Duro, Penchlor, Vitrex ....12 hours
Alkor .....24 hours
Nuken Resinous .....36 hours

The question is frequently being asked: How far on the alkaline side can one bring a solution without harming the glass lining or breaking down the repair cement? This question is difficult to answer because the nature of the solution and the temperature at which the solution is being processed are both important factors which must be considered. A product at ph 9.5 may be entirely harmless at 86 deg. F. and become very detrimental to glass at 165 deg. F. If the alkaline condition is too high the glass lining will soon take on a dull appearance. Before subjecting a vessel to an alkaline condition it is well to inspect the tank and look for ceramic plugs. The ceramic plugs should be replaced with gold plugs.

Whether or not your alkaline condition is too severe for a glass lined vessel can best be determined by running an experiment using Pfaudler test cups or test bars obtainable from Glascote Products, Inc.

The procedure for the installing and replacing of gold and ceramic plugs has been omitted. It is felt that these operations require tools not commonly available in the average shop and such repairs should not be attempted without special training.



Pale plant. Here color bodies in rosin-naphtha solution are adsorbed. Naphtha and terpene traces are removed from rosin

From Pine Stumps to Rosin and Terpene Oils

J. V. HIGHTOWER
Southwestern Editor, *Chemical Engineering*

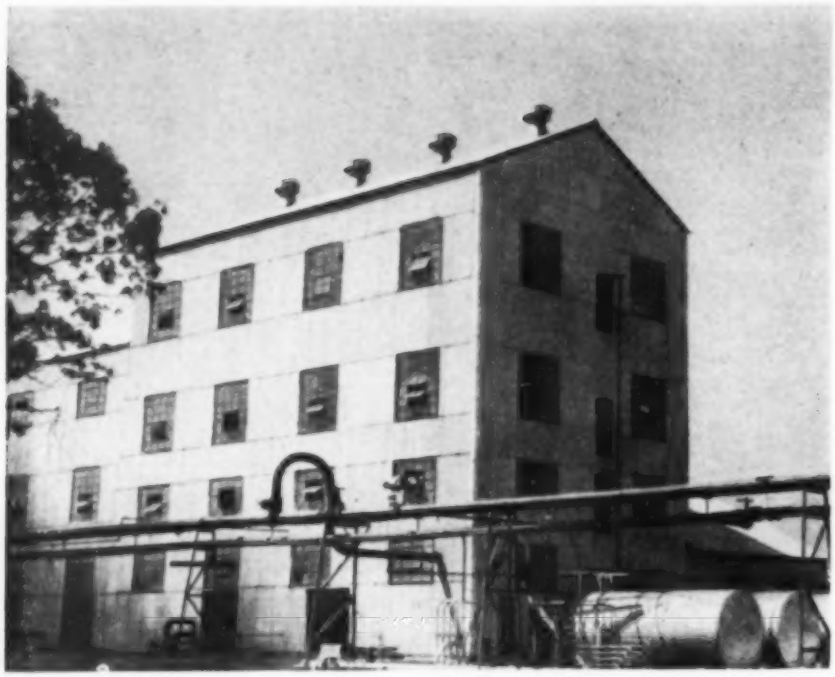
NEW NAVAL STORES PLANT DAILY TURNS 750 TONS OF PINE STUMPS INTO 450 DRUMS OF ROSIN AND 8,000 GAL. OF TERPENE OILS

FOLLOWING a policy of expansion, Crosby Chemicals, Inc., completed and put into operation this year at its second steam-distilled wood naval stores plant, at De Ridder, La., a rosin-refining unit which utilizes an adsorption process developed by the company. The new unit permits the manufacture of a number of pale wood rosins corresponding in color to the gum rosin types. It has considerably increased the number of products which the company is producing from long leaf yellow pine stumps from thousands of acres of cut-over land in southwestern Louisiana.

The Crosby plant is operating at its current capacity of 750 tons of stumps per day. The company contemplates an enlargement of this capacity. At present the limit on capacity is the extractor system. Eventually more extractors will be added to the system, thereby permitting daily capacity to be raised to 1,000 tons.

Situated about two miles outside De Ridder, the plant is the compact, well-designed center toward which scores of stump-laden, flat-topped trucks move all day from an average radius of 35 mi. The hauls vary, however, from 1 mi. to 65 mi., the present maximum. The company owns slightly

Equipment for fractional distillation of terpenes and adsorption towers for decolorizing rosin give the newest plant of Crosby Chemicals, Inc., at De Ridder, La., great flexibility in production. It can make such terpene specialties as turpentine, alpha pinene, dipentene, pine oil and alpha terpineol plus a variety of grades of refined wood rosin.



In this FF refinery and still house solvent naphtha used in initial extraction step is recovered. Then terpene oils are separated from rosin by fractionation

over 100,000 acres and has contracts for stumps from an additional 400,000 acres. Estimates place the total supply at between 20 and 40 years. Crosby contracts for the excavation and hauling of the stumps. Approximately 500 men work in the field, uprooting the stumps with bulldozers, dynamiting and chopping the unwieldy masses to handling size.

A high degree of flexibility characterizes the operation of the plant, and company officials consider there is virtually no limit to the products which can be manufactured from the complex mixture of chemicals in the wood. Included in the list of products which have been or are being manufactured are FF wood rosin and refined pale grades; limed wood rosins; turpentine; standard, amber and XH pine oils; dipentene; alpha pinene; and several high-melting resins. Research is being conducted to develop new products as well as new applications of existing materials.

Current Production

Current production is at the daily rate of over 450 drums of rosin and 8,000 gal. of combined terpene oils from which other products are ultimately manufactured. The plant operates 24 hr. per day and processes stumps from a large stockpile when not taking the wood directly off the trucks. Down time for repair is quite low, and has totaled only about two weeks during the first year of operation, which started in November 1946. The rosin-refining facilities began operating last February. The plant employs about 350 men including its technical staff.

Mill Room

The conversion of roots, stumps and topwood of long leaf yellow pine, which must be a minimum of seven years old for best results, begins when the material is fed into the mill room. This building houses two lines of grinding equipment, each consisting of a "hog," in which knives are studded on a rotating member, and two hammer-type shredders. Stumps may be fed to either or both lines. The stumps are thrown either directly from the trucks or from the stockpile upon heavy chain conveyors which move them along steel channels and beneath streams of water for removal of dirt. Each line of stumps then moves onward into the front end of the mill room and into the top of the hog. The small pieces drop from the bottom of the hog upon a chain conveyor which drops them upon a vibrating screen before reaching the first shredder. Fines from the screen bypass the shredder and move directly to the storage bin. Wood retained on the screen passes into the shredder, and the discharge from this is again screened, the chips falling into the second shredder. The final product is a mixture of fines and chips, of which only 15 percent is retained on a ¼-in. mesh.

Extractor House

From the second shredder the mixture is moved on a belt conveyor to the top of the storage bin. From the bottom of the bin the wood is discharged upon another belt which carries the material to a third belt which feeds 16 steel extractor vessels in the extractor house. By means of a "tripper" on the feed belt at the tops of the vessels, the operators can dump chips into any of the extractors when the bolted cover has been removed. Each extractor contains about 15 tons of chips, which are supported at the bottom on a steel screen resting on a perforated plate. The extractors are insulated to reduce heat losses.

Solvent Extraction

Extraction is continuous, although at any one time only ten vessels are in the extraction phase. The solvent is a relatively narrow petroleum fraction, having initial and final ASTM boiling points of 200 and 240 deg. F. respectively. At a temperature ranging between 265 and 280 deg. F., the solvent is pumped into the bottom of the first of ten extractors, from the top of this into the bottom of the second, proceeding thus in series through the ten vessels. Extractor pressure runs from 65 to 85 psi. ga. After about 9,000 gal. of solvent has been pumped through the tenth extractor, No. 1 is cut out of the system, a "fresh" extractor is added to the line, and fresh solvent is then pumped into No. 2 until 9,000 gal. has run through No. 11. In this manner fresh solvent is always being charged to the vessel containing the most nearly exhausted chips. The ratio of fresh solvent to fresh chips averages 600 gal. per ton.

In the meantime, No. 1 extractor is being steamed with 100-lb. steam which enters at the bottom. The vapors, with the residual solvent, are carried to a condenser where the solvent is recovered. Loss of solvent is negligible. After steaming the extractor for 1 hr. the small rectangular door near the base of the extractor is opened and the spent chips are removed manually, thrown upon a chain conveyor and moved ultimately to the boiler house to be burned as fuel. No. 1 extractor is then charged with chips.

The crude solution of rosin and terpene oils leaving the last of the ten extractors enters a system of "drop," or intermediate storage, tanks and is

ready for processing in the FF refinery and still house building. The solution is pumped into two vertical-tube, atmospheric-pressure evaporators connected in parallel. Most of the solvent is evaporated here and returned to the solvent system. Bottoms from the evaporators are pumped to a flash tower where the remainder of the naphtha is removed. Steam jet ejectors maintain a vacuum of 15 in. Hg in this tower. The mixture of rosin and terpene oils is pumped to two "finishing towers," or fractionators, connected in series, where with the aid of stripping steam the terpene oils are removed overhead and FF rosin is discharged from the second tower and made ready for refining. A vacuum of 27 in. Hg is maintained in the towers.

Terpene Oil Processing

Processing of the terpene oil mixture is the next step. The oils, after passing through a separator where water is drawn off, are pumped into tanks and agitated with a 20 percent aqueous caustic soda solution to remove aldehydes and improve odor. Following treatment with caustic the oils are charged to one or more of three batch stills where the charge is fractionated into turpentine, pine oils and other components which are desired from time to time. The batch stills are also used for re-fractionation of a primary distillate, such as turpentine. Turpentine, alpha pinene, dipentene, pine oil, alpha terpineol and terpene specialties are typical final products. Still bottoms remaining after fractionation of the terpene oil mixture are pine oil foots, which are sold to other processors. Finished products are shipped in quantities ranging from pints to tank-car lots.

Yields

Yields of finished products are difficult to report because of the wide variation in types of products manufactured at various periods. However, one ton of chips usually will yield 320 lb. of unrefined (FF) rosin and 85 lb. of terpene oils. The rosin yields, on a weight basis, 85 to 90 percent of pale stock and 15 to 10 percent color bodies. The terpene oils average, by weight, 57 percent turpentine, 36 percent pine oil and 7 percent dipentene.

Until last spring the De Ridder plant marketed its FF rosin without further refining. However, completion last February of the rosin-refining plant has made possible the marketing of a large volume of pale rosins of various grades required for such products as paper size, ester gums, varnishes, soaps, synthetic resins and adhesives.

Mixing Tanks

The still molten FF rosin is pumped to a battery of four mixing tanks outside the "pale plant" where the refining is performed. In these tanks fresh naphtha from the solvent system is mixed, by means of electrically driven paddles, with the rosin until a 50 percent solution is produced. Excess heat contained in the hot rosin is removed by means of a coil through which cooling water circulates. Each mixer has such a coil. The solution is then pumped from the mixers into a battery of six wash tanks and combined with enough additional naphtha to thin it to 15 percent rosin content.

Color bodies are washed out of the rosin by water sprays directed into the solution from the tops of the washers. Water accumulating in the lower parts of the washers is picked up by a centrifugal pump and carried back to the sprays. From the bases of the washers nigre, a heavy, dark resin having a melting point of 230 deg. F., is periodically drawn off. Nigre constitutes about 3.5 percent of the FF rosin.

Pale Plant

Following the removal of nigre, the rosin-naphtha solution is pumped into the pale plant, where the final color reduction is accomplished by adsorption on magnesium trisilicate packed in 16 adsorption towers. The use of this adsorbent was developed by Crosby through research and development conducted in its extraction plant at Picayune, Miss. Each tower is 7 ft. in diameter and 21 ft. high and contains about 14 tons of adsorbent. At any one time, only three of the towers are in the adsorption phase, and the rosin solution is pumped through the three towers in series, entering No. 1 at the bottom. The volume moved through the three towers depends on the grade of rosin desired.

When the required quantity of solution has passed through No. 3 tower, the solution charge pump is closed. Solution remaining in the three towers is then driven through a fresh tower, No. 4, and from there into the solution storage tanks, by means of a stream of naphtha pumped through the towers beginning with No. 1. The naphtha wash stream is then shut off and rosin solution begins feeding into No 2 and discharging to storage from No. 4.

Pale rosin solution is pumped from storage into two vertical-tube evaporators connected in series, where the naphtha is removed. The first evaporator operates at atmospheric pressure and the second functions under a vacuum of 15 in. Hg. The rosin, containing a small amount of terpene oils, is then pumped to a final fractionator where the oils are removed and recovered.

The rosin is pumped to the rosin shed where it is either packed as such or converted into paper size or limed rosin. In manufacturing size the rosin is cooked with 25 percent aqueous soda ash solution in a steam-coil-heated vat. Limed rosin, for use in varnishes, gloss oils and matches, is produced by stirring into the hot rosin 3 to 4 percent of calcium hydroxide.

Berez

As a byproduct of pale rosin manufacture, the plant produces Berez, or B wood rosin, a dark material averaging 190 deg. F. melting point and used, where dark color is no objection, for such commodities as paper size, asphalt emulsions, adhesives, varnishes, linoleum and insulating boards. Berez remains in the adsorbent towers where the rosin is given its final decolorizing treatment as described above. After a tower removed from the system has been given a naphtha wash it is then washed with a stream of 95 percent ethanol, which carries the Berez in solution to storage.

From storage the Berez solution is pumped to two atmospheric-pressure, vertical-tube evaporators connected in series, where the alcohol is removed. The Berez is pumped to a final fractionator for removal of terpene oil traces. The rosin is shipped either in tank cars or in 550-lb. drums.

Rules against smoking are enforced in the plant because of the possibility of fire, and the use of fireproof materials is general. The processing buildings have concrete floors, steel frames and asbestos sidings and roofs. A high degree of ventilation is present. The office, laboratory and library building is of concrete and is air-conditioned. Total laboratory floor space is about 3,000 sq. ft.

Fuel is no problem. Spent chips from the extractors furnish the fuel for generation of steam and electricity. However, the company maintains standby power connections and also has access to natural gas.

A pictured flowsheet illustrating the processes described in this article for the production of naval stores at the Crosby plant will be found on pp. 150-153 of this issue of *Chemical Engineering*.

Rough Evacuation of Vacuum Systems

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THIS ARTICLE COMPLETES THE STUDY OF HIGH VACUUM CALCULATIONS COMMENCED BY THE AUTHOR IN THE NOVEMBER ISSUE OF THIS MAGAZINE

On pages 127 to 131 of our November issue Mr. Dryer showed in detail how flow under high vacuum conditions, in the micron pressure range, differs from flow at ordinary pressures. He indicated how to distinguish between flow in the viscous range and that in the free molecular range, and how to calculate each. The present article demonstrates how to handle the intermediate range where both types of flow exist, and gives methods for calculating pumping time with mechanical pumps.

IN RECENT YEARS there has been an accelerated development of processes calling for pressures so low that the ordinary laws of fluid flow can not be used to predetermine design. An earlier article (Dryer, *Chem. Eng.*, pp. 127-131, November 1947) considered the properties of such low pressure systems and offered a group of equations for calculating flow rates and conductances, both in the range of viscous flow and in the extreme low pressure range where flow is free molecular.

However, it was pointed out that in the pressure range roughly from 10^3 to 10^{-3} microns Hg, both viscous flow conductance and free molecular flow conductance are appreciable in magnitude and have to be reckoned with. Being in parallel the two conductances are added to give the combined conductance.

Viscous vs. Free Molecular

It is informative to compare the relative magnitudes of the two conductances in a pipe throughout the range of pressure from 10^3 to 10^{-3} mm. Hg. Table I shows how the two conductances vary, first in a 4-in. diameter pipe, then in a 30-in. diameter pipe.

The values are computed from Eqs. (16) and (20) in the first article which combine to give Eq. (34) stated below. This equation applies to air at 80 deg. F. (300 deg. K.) in a straight round pipe (neglecting the entrance effect). The combined conductance, in liters per sec. equals:

$$2.94\frac{u_a\, d^4}{L} + \left(79\frac{d^3}{L}\times\frac{1+0.62\,du_a}{1+0.76\,du_a}\right) \qquad (34)$$

Viscous conductance — Free molecular conductance

where d is the diameter of the pipe, inches; L is the length of the pipe, inches; and u_a is the average pressure along L, microns Hg.

It will be seen from Table I that while in each case the viscous flow conductance is proportional to the pressure, the free molecular flow conductance varies only about 18 percent throughout the whole range of pressure. At the highest pressures free molecular flow conductance is negligible, whereas at the lowest pressures the viscous flow conductance is negligible. The value of the free molecular flow conductance is asymptotic at both the highest and lowest pressures. Continuing the pressure range either way would not change the extreme values shown; its maximum possible value, as is evident from the free molecular part of Eq. (34), is $79\ d^3/L$ and its minimum is 0.62/0.76 or 82 percent of that.

It should be noted that the minimum value of combined conductance is not at the lowest pressure, and that as a result a good approximation to use for the combined conductance throughout a long range of low pressures is the maximum possible value of free molecular flow conductance, that is, $79\ d^3/L$. For the 4-in. pipe this is 420, and for the 30-in. pipe, 178,000.

This same Eq. (34) can be used to establish the lowest pressure above which the value of the viscous flow conductance alone might be taken for all practical purposes as being the value of the total conductance of a pipe. The same pressure will be the low pressure limit for the use of the viscous flow resistance Eqs. (7) (8) (7a) and (8a). In connection with these four equations it was stated that they might well be used down to the pressure where the free molecular flow became 10 percent of the viscous flow, thereby accepting as an error 10 percent more flow than the pressure drop would indicate.

In connection with Eq. (11) it was stated that this low pressure limit was $u_a = 220\ d$ where u_a is the average pressure along the length of the pipe, in microns Hg; and d is the diameter of the pipe, in inches. When $u_a < 220/d$, free molecular flow conductance > 10 percent of viscous

This paper and the one by the same author which preceded it are based on work performed under Contract Nos. W-7401-eng-13, W-14-108-eng-49, and W-14-108-eng-60 for the Manhattan Project at the Stone & Webster Engineering Corp. The information covered in these two papers will appear in Division I of the Manhattan Project Technical Series, as a part of the contribution of the Stone & Webster Engineering Corp.

Table I—Comparison of Viscous and Free Molecular Conductances in Two Sizes of Pipe, Liters per Sec., per Foot of Length

	Conductance per Ft. of Pipe Length, Liters per Sec.					
	4-In. I. D. Pipe			30-In. I. D. Pipe		
Pressure, Microns Hg.	Viscous Flow	Free Mol. Flow	Combined Flow	Viscous Flow	Free Mol. Flow	Combined Flow
1,000	62,600	342	62,942	19.8×10^7	145,000	19.8×10^7
100	6,260	343	6,603	19.8×10^6	146,000	19.9×10^6
10	626	344	970	19.8×10^5	146,000	21.3×10^5
1	62.6	362	425	19.8×10^4	147,000	345,000
0.1	6.26	400	406	19.8×10^3	155,000	174,800
0.01	0.62	416	417	19.8×10^2	175,000	176,980
0.001	0.06	420	420	19.8×10^1	178,000	178,198

flow conductance; and when $u_s > 220/d$, free molecular flow conductance < 10 percent of viscous flow conductance.

Originally Eq. (11), stating the low pressure limit for viscous flow, was derived from Eq. (34) by letting the free molecular flow term in the latter equal 10 percent of the viscous flow term. Then $(79d^3/L)\ [(1 + 0.62du_s)/(1 + 0.76du_s)] = 0.10\ (2.94u_sd^3/L)$, or $u_s = 220/d$.

As in the case of the low pressure limit, Eq. (34) was also used to establish Eq. (20a) which sets the highest pressure below which only the free molecular flow Eqs. (20) to (33a) may be used for all practical purposes for computing the total conductance of pipes and other channels. The derivation of Eq. (20a) is by a similar method to that shown above, in this case letting the range for using free molecular flow conductance alone extend up to the pressure where viscous flow conductance is 10 percent of it. Then $0.10\ (79d^3/L)[(1 + 0.62du_s/(1 + 0.76du_s)] = 2.94u_sd^3/L$ and $u_s = 2.2/d$. Therefore, when $u_s < 2.2/d$, viscous flow conductance < 10 percent free molecular flow conductance, and when $u_s > 2.2/d$, viscous flow conductance > 10 percent free molecular flow conductance.

Combined Equation Range

The two limits set above establish the range in which the combined viscous and free molecular flow conductance equation should be used, that is, from $u_s = 2.2/d$ up to $u_s = 220/d$, a pressure range of 100 fold.

Summing up, for computing the total conductance, use only viscous flow conductance equations down to the pressure where $u_s = 220/d$. Use only free molecular flow conductance equations from the lowest pressures up to the pressure where $u_s = 2.2/d$. In the pressure range between these use the combined viscous and free molecular equation.

Pump Size—Mechanical pumps (as well as ejectors) are employed for the first stage of the evacuation of a vessel and are able to take the pressure down well under 50 microns. Diffusion pumps can take hold effectively at about 100 microns. Since they have large evacuating capacity, they are brought into action at about that pressure to reduce to lower pressures, with mechanical pumps for backing.

During the first stage of evacuation, i.e., the roughing stage carried out by a mechanical pump, the problem in many engineering processes is the simple one of removing gas initially inclosed in the vessel. No gas is evolved from the process in the vessel or from the surfaces of the equipment, and leakage is of negligible magnitude. A method is given here for determining the capacity of the roughing pump required or, alternatively, for calculating the time consumed in attaining the rough vacuum with no out-gassing or leakage.

Mechanical Pump Evacuation

A mechanical roughing pump has constant displacement. Its volumetric efficiency decreases with pressure. A typical mechanical pump with a theoretical displacement of 300 cfm. has a nominal volumetric efficiency averaging about 0.77 in the range from atmospheric pressure to a little below 100 microns. Allowing for its valve setting and deterioration, it is better to take the actual efficiency in that range as being 0.65. The pump capacity will therefore be taken as having a constant effective displacement of $(300 \times 0.65) \times 28.3$ liters per min., i.e., 5,500 liters per min. Assuming a vessel being pumped down under these conditions (no out-gassing or leakage, and a pump of constant volumetric displacement), the pressure in the vessel will decrease exponentially thus:

$$u_2 = u_1\, e^{-st/v} \qquad (35)$$

Rearranging Eq. (35):

$$t = (v/s)\ \log_e\ (u_1/u_2) \qquad (36)$$

$$s = (v/t)\ \log_e\ (u_1/u_2) \qquad (37)$$

where u_1 is the initial tank pressure, microns Hg; u_2 is the final tank pressure, microns Hg; e is 2.718; s is constant effective displacement of the pump, liters per min.; v is the volume of the vessel, liters; and t is the time consumed in reducing pressure from u_1 to u_2, minutes.

Table II—Design Data for 303 Cfm. Pump at 80 Deg. F. on Air

u_2, Pump Pressure, Microns Hg.	Volumetric Efficiency, Percent	f_1, Air Flow Measured at Pump, Liters per Sec.
100	48	68.7
80	44	63.0
60	38	54.3
40	26	37.2
20	0	0

Table III—Calculated Flow From Tank Reduced by Pipe and Pump Losses

Pipe			Pump			
d	u_1	f_1	Eff.	u_1f_1	u_2	f_2
6	83	64	45	5,300	100	53
4	50	47	33	2,350	100	24
3	34	28	21	950	100	9.5

As an example, a 10,000-liter vessel containing gas at a pressure of 1 atm. (760,000 microns) has to be evacuated to 96 microns. How long will that take, if the pump has a constant effective displacement of 5,500 liters per min.? From Eq. (36) $t = (10{,}000/5{,}500) \log_e (760{,}000/96) = 16.3$ min.

Another method for ascertaining the time consumed is to use the "half-life" principle of Eq. (35), thus: Let t_1 be the number of minutes elapsing during any period in the evacuation in which the pressure is halved. Then:

$$t_1 = 0.7\ (v/s) \qquad (38)$$

As proof of Eq. (38), note from Eq. (36) that $t_1 = (v/s) \log_e (2/1)$. Then $t_1 = 0.693\ (v/s) = 0.7\ (v/s)$ approximately.

That applies all the way down the pressure range. Applying this method to the foregoing example, where $t_1 = 0.693\ (10{,}000/5{,}500) = 1.26$ min.:

At End of Period No.	Minutes Elapsed	Pressure, Microns
0	0	760,000
1	1.26	380,000
2	2.52	190,000
3	3.78	95,000
4	5.04	47,500
5	6.30	23,750
6	7.56	11,875
7	8.82	5,937
8	10.08	2,969
9	11.34	1,484
10	12.60	742
11	13.86	371
12	15.12	186
13	16.38	93

That is 16.38 min. elapses in reducing the pressure to 93 microns. It might be noted that from Eq. (36) the total time t in this example to reduce to 96 microns would be $(v/s) \times 8.98$ min. Hence from Eq. (38), $t/t_1 = (8.98\ v/s)/(0.7v/s) = 13$ approximately; that is, the total time to reduce to 96 microns is about 13 "half-life" periods.

The methods shown above may be used to give a fair estimate of the time needed for evacuation with good size vacuum pipes. However, with small

pipes the time will be longer since, on account of the pressure loss in the pipes, the volumetric efficiency of the pump decreases to a marked degree. This matter is examined in the next succeeding section.

Rough evacuation (or coarse evacuation) occurs when the lowest pressure involved is not below the range in which only viscous flow conditions need be reckoned with. As shown in Eq. (11), this lowest pressure is when $u_a = 220/d$, u_a being the average pressure along the length of a pipe, in microns Hg, and d the inside diameter of the pipe in inches. For example, when $d = 6$, $u_a = 37$, while if $d = 3$, then $u_a = 73$.

Pipes for Rough Evacuation

As mentioned in the preceding section the time consumed in rough evacuation is longer the smaller the pipes. The following example will show how to determine the size of pipes for whatever length of time it is decided to allow for rough evacuation:

What is the size of pipe needed for pumping down the pressure of a tank filled with air at atmosphere pressure and at 80 deg. F.? The pumped-down pressure required in the tank has to be 100 microns Hg. The pipe is 100 ft. long. The vacuum pump used will be a mechanical pump having a theoretical displacement of 303 cfm. Assume no leakage, and also no gas evolved in the tank. The pipe size needed is found by use of the viscous flow resistance Eq. (8a) which is:

$$u_1^2 - u_2^2 = 0.68\, L u_2 f_2/d^4 \qquad (8a)$$

Here u_1 and u_2 are the pressures at tank and pump, respectively, in microns Hg; L is the pipe length in inches; f_2 is the actual liters per sec. at the pump; and d is the pipe diameter in inches. Various diameters of pipe could be used, each giving a different pressure drop in the line. That means for each size a different u_2 pressure at the pump, with 100 microns at the tank. The volumetric efficiency of mechanical vacuum pumps decreases with the pump pressure—rapidly below 100 microns. For example, operating experience shows that the data in Table II are fair values to take for design purposes when using a 303 cfm. pump with air at 80 deg. F.

From Table II a curve may be plotted of u_2 against f_2, which will give the associated values of these two quantities to insert in Eq. (8a) rewritten for this problem, using $u_1 = 100$, and $L = 1{,}200$, thus:

$$u_2 = \sqrt{100^2 - 0.68\,(1{,}200\, u_2 f_2/d^4)} \qquad (39)$$

For any size of pipe d, by simple trial and error, the value of u_2 can be found that will satisfy this equation. It will be found that for 6, 4 and 3-in. pipes the values of u_2 and f_2 are as listed in Table III. Letting f_1 be the flow from the tank, liters per sec., and u_1 be the pressure in the tank, microns Hg, the values of f_1 are as noted in Table III, since $u_1 f_1 = u_2 f_2$.

The values of f_1 in Table III are seen to be much lower than the 92 liters per sec. (i.e., 5,500 liters per min.) assumed in the preceding section on mechanical pump evacuation to be an average f_1. This means that in the last stages of the evacuation, the rate of reduction of tank pressure is much lower than indicated by Eq. (38). Not only is f_2 the effective displacement of the pump much reduced, but the pressure loss in the pipe f_1 makes it still lower. By using the equations in the preceding section mentioned, the time for the final evacuation stages can be determined for any size of pipe. Hence, the pipe size to be used can be chosen by deciding how long a time for evacuation is acceptable.

It should be explained that when u_2 takes the low values shown in Table III for 3-in. pipe, Eq. (8a) does not hold strictly, since the lower limit of pressure for its application, as set by Eq. (11), has been transgressed.

"Six-Tenths Factor" Aids in Approximating Costs

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PROCESS EQUIPMENT COSTS

LIKE ENGINEERS in other fields, those chemical engineers who are concerned with equipment costs have developed "rules of thumb" over the years to aid their work. One of the most valuable of these is the so-called "six-tenths factor" which is used in approximating the cost of a piece of equipment or a complete plant when the cost of a similar unit of different size is known. To restate this rule, if the cost of a given unit is known at one capacity and the cost is desired at a second capacity x times the first, multiply the known cost by $x^{0.6}$ to obtain the cost at the second capacity. (See writer's earlier article, *Chem. Eng.*, p. 102, June 1947.)

Since this rule is so valuable and so widely used, it was felt desirable to check its accuracy. This has been done by statistical analysis of available data.

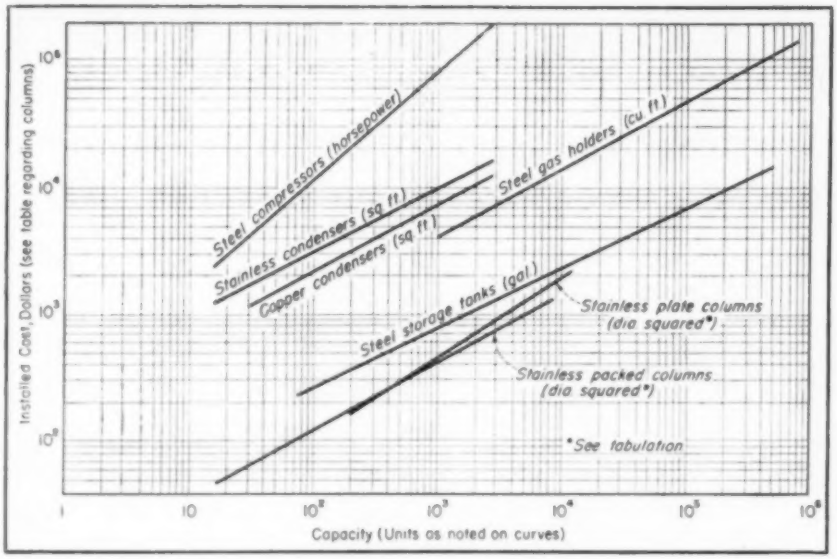
Correlation of equipment cost data has been practiced for many years by chemical engineers who use such information. One method of correlation has been to plot the cost of equipment against capacity on logarithmic scales. It has been pointed out before (Williams, *loc. cit.*) that this type of plotting leads to straight lines, and hence to the conclusion that equipment costs may be correlated by equations of the form $y = ax^b$ where y is the cost, a is a constant for the type of equipment involved, x is the capacity of the unit, and b is also a constant. Assuming equations of this type, the following shows that the constant b in this equation is the six-tenths factor and hence, according to the rule, is a general constant and not specific for a given type of equipment, since the rule is not so limited.

Let x_1 = capacity of the first unit, x_2 = capacity of the second unit, y_1 = cost of the first unit, and y_2 = cost of the second unit. Then $y_1 = ax_1^b$ and $y_2 = ax_2^b$. Dividing y_2 by y_1 gives $y_2/y_1 = (x_2/x_1)^b$, or $y_2 = y_1\,(x_2/x_1)^b$.

The latter equation becomes the six-tenths factor expressed in formula form when $b = 0.6$. Therefore, by deriving the equations representing the costs of several different types of equipment we should find that the exponents are all approximately equal to 0.6 if the rule of thumb holds.

Derivations of the cost formula*

* The derivations were made by the method of least squares, minimizing the squares of the deviations of the calculated costs from the observed costs. There may be some question whether or not this is the best derivation since this method minimizes the absolute values of the deviations between the actual and calculated points, rather than minimizing the percentage errors. It is not believed, however, that this causes much error in the equations. The probable error for each equation has been calculated statistically. It is to be regretted that only 19 to 29 actual unit costs were available from which to derive the equations. This small number of points gives a result which is subject to a rather wide margin of error. The probable errors derived illustrate this.


Installed Cost, Dollars (see table regarding columns)
Capacity (Units as noted on curves)
Steel compressors (horsepower)
Stainless condensers (sq ft)
Copper condensers (sq ft)
Steel gas holders (cu ft)
Steel storage tanks (gal)
Stainless plate columns (dia squared*)
Stainless packed columns (dia squared*)
*See tabulation

Cost-capacity formula plots for seven equipment classes

have been made for storage tanks, compressors, gas holders, condensers, and both plate and packed distillation columns in order to check the rule. Following the writer's general method of correlation (*loc. cit.*) the installation costs have all been revised to an *Engineering News-Record* construction cost index of 300 (ca. January 1945).

Results of the analysis are shown in the accompanying tabulation. The individual calculated exponents vary from a low of 0.48 to a high of 0.87, but six of the seven figures fall between 0.48 and 0.63 and the average of the seven figures is 0.59, very close to the predicted 0.60. Although this is not completely satisfactory evidence, the result is surprisingly close to the rule of thumb, considering the small number of points available for analysis. In the case of storage tanks, one of the exponents falling far from the predicted 0.60, the writer can hardly believe the results. In a previous correlation (*loc. cit.*) using prewar as well as up-to-date figures the writer derived an exponent of 0.59, compared to the 0.48 which this analysis shows. Dickson on the other hand (*Chem. Eng.*, p. 122, Aug. 1947) has arrived at 0.7 as the correct figure for tanks.† Similarly the compressor figure is open to question because no correction was made for pressure operation. High-pressure units were eliminated, that is those with output pressures over about 400 psi., but below this all compressors, centrifugal as well as reciprocating, were lumped together and compared on a horsepower basis.

Probable errors shown for the two types of distillation columns are interesting. Towers have been correlated by plotting the diameter of the column against the dollars per foot of height in the case of packed towers, and dollars per plate in the case of plate columns. Obviously for any given diameter unit, the cost per unit height should be greater for a short column than for a tall one. The correlation has not taken this into account, and yet the probable errors shown are in the 20 percent range.

In working out the equations the diameter squared, rather than just the diameter, has been used since this is a more accurate measure of the capacity of a column.

Specifications, Cost Formulas and Probable Error for Various Equipment Classes

Equipment	Material of Construction	Unit of Capacity	Size Range Available, Smallest to Largest	Number Unit Costs Available	Formula	Probable Error, Percent
Storage tanks	steel	gallons	75 to 500,000	27	$y = 30x^{0.48}$	±17.3
Compressors	steel	horsepower	15 to 2,700	26	$y = 210x^{0.63}$	28.3
Gas holders	steel	cubic feet	1,000 to 750,000	19	$y = 99x^{0.51}$	13.5
Condensers	copper	square feet	30 to 2,600	28	$y = 188x^{0.54}$	9.7
Condensers	stainless	square feet	15 to 2,600	35	$y = 303x^{0.51}$	20.9
Plate columns	stainless	diam. squared	14 to 110*	39	$y = 6.47x^{0.86}$	16.5
Packed columns	stainless	diam. squared	4 to 90*	27	$y = 9.82x^{0.86}$	21.2

Note: In formula x is capacity in units noted. Cost y is total dollars installed cost except in the case of columns, where it is dollars per plate for plate columns, and dollars per foot of height for packed columns. Arithmetic average exponent = 0.59; arithmetic average probable error = 18.2 percent.

* Sizes shown here are actual diameters in inches, not diameters squared.

A further interesting observation about the probable errors shown is the wide range of capacities they cover. The largest tank is 6,670 times as large as the smallest; for gas holders the capacity ratio is 750; for condensers the ratios are 87 and 184 times, and the columns have ratios of largest diameter squared to smallest of 62 for packed columns and 506 for plate towers. The fact that these single equations can cover such a wide range with only a 20 percent probable error, or less, is quite amazing.

Support for the Rule

These two factors, the closeness of the majority of the exponents to 0.6 and the low probable errors considering the paucity of the data and the wide range of capacities, make the statistical results lend credence to the sixtenths factor as a general rule to follow. The factor cannot and should not supplant the actual collection of data as a method of correlating costs, but when the necessary data are lacking its use gives a surprising accuracy.

In acknowledgment the author wishes to mention the assistance of Miss Mary Dunleavy who carried out the statistical calculations.

†*Editor's Note*—Mr. Dickson, in the article referred to here, used a formula for tank cost of the form $c = a\ b^{0.3}\ x^{0.7}$, where c is the cost of any tank, a is the cost per unit of capacity of a standard tank, b is the capacity of this standard tank, and x is the capacity of a tank whose capacity is desired, both capacities being in the same units. Private communications from author Williams and from R. L. Womer, Research & Development Division, Western Cartridge Co., East Alton, Ill., have pointed out that Mr. Dickson's formula can be recast in the form of $y_2 = y_1(x_2/x_1)^{0.7}$, where y is the cost and x the capacity, the subscript (2) referring to the tank whose cost is desired, and the subscript (1) referring to the tank whose cost is known.

Mr. Womer went farther and explored the possibility that the 0.7 exponent used by Mr. Dickson might have more than an empirical justification. He noted that, in the case of the spherical tanks also covered by Mr. Dickson's formula, the ratio of surface areas of two tanks is equal to the ratio of volumes to the ⅔ power, which is very close to an exponent of 0.7. In spherical tanks of differing diameters, but the same shell thickness, one would expect the relative costs to vary in some manner with the amounts of material, that is, with the surface areas, and hence as the ratio of volumes to the ⅔ power. In the case of cylindrical tanks he noted that if they were of the same shell thickness, and had the same ratio of length to diameter, then the surface areas (amounts of material) would also vary as the ⅔ power of the ratio of volumes. This too points to a theoretical justification for the 0.7 factor.

However, tanks will ordinarily increase in shell thickness with increase in diameter. This is necessary to maintain a constant unit stress in the shell material, since the unit stress in a thin cylinder is proportional to both the pressure and the diameter. Therefore the weight of material will increase more rapidly than the increase in surface area, and the cost might be expected to increase more rapidly than the ⅔ power of the ratio of volumes. Against this is the fact that the cost per pound of tank for fabrication, handling and installation decreases markedly as the size increases (L. E. Fox, *Chem. Eng.*, p. 100, Aug. 1947) which offsets (or, according to Mr. Williams' formula, more than offsets) the increase in weight per unit of surface area.

Process Engineer's Guide to the C

ADIABATIC HEAD CALCULATIONS FOR GASES OTHER THAN AIR, FOR GAS MIXTURES AND FOR LOW-PRESSURE GASES ARE COVERED HERE

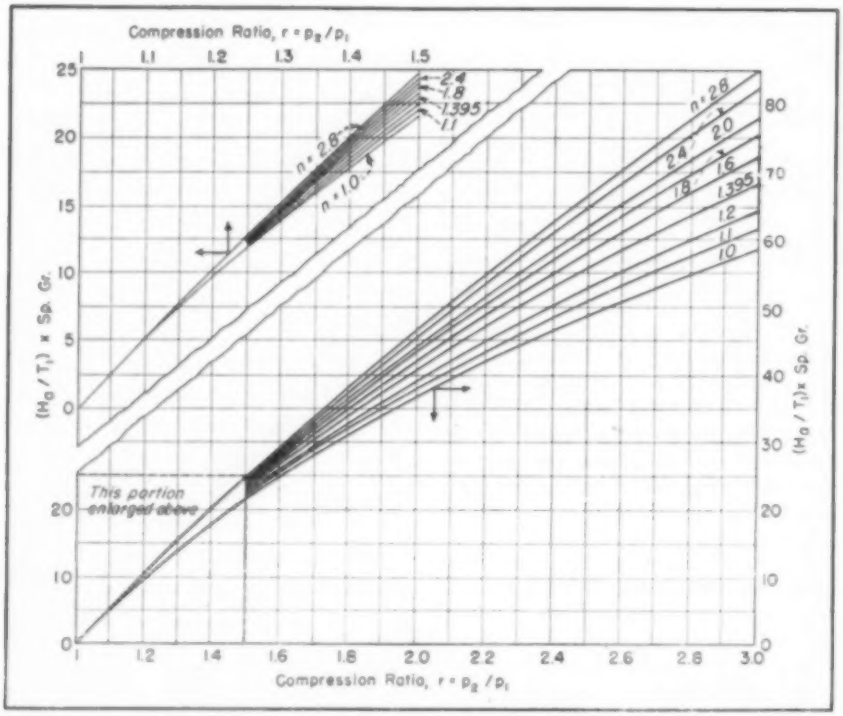


Fig. 1—Values of $(H_o/T_1) \times$ sp. gr. for various values of n and for ratios of compression from 1 to 3

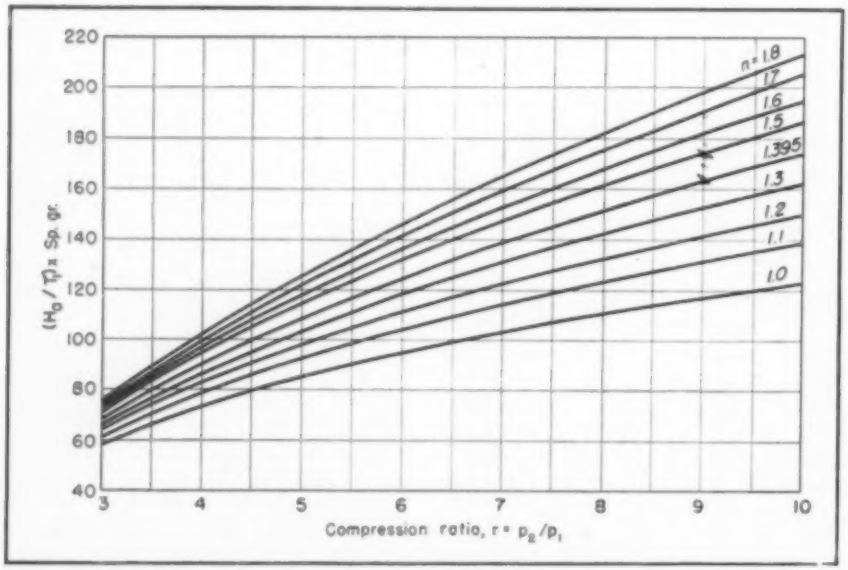


Fig. 2—Values of $(H_o/T_1) \times$ sp. gr. for various values of n and for ratios of compression from 3 to 10

Started in our October issue and continued in November, this series of five articles takes the mystery out of the centrifugal compressor and shows the process engineer how to make all calculations needed from an application standpoint. The important concept of adiabatic head was discussed in the last article, and applied to air. Methods given here extend the calculation to other gases as well as to mixtures of gases.

IN AN EARLIER ARTICLE of this series we have seen that the formula for the adiabatic head H_a, i.e.,

$$H_a = 144 \left(\frac{k}{k-1}\right) p_1 v_1 (r^{(k-1)/k} - 1)$$

can be transformed into a rather simple relation between the head, the inlet temperature and the ratio of compression, for a given value of the specific heat ratio k:

$$\frac{H_a}{T_1} \times \text{sp.gr.} = 53.34 \left(\frac{k}{k-1}\right) (r^{(k-1)/k} - 1)$$

If we now select a range of values of compression ratio r to cover the probable range of application of centrifugal compressors and plot against it values of $(H_a/T_1) \times$ sp.gr. for a series of values of k, we shall have a ready means available to calculate the adiabatic head required to produce any selected ratio of compression for any gas of which we know the characteristics. Such a group of curves is presented in Figs. 1 and 2. It will be noted that instead of labeling the various curves with their respective k values, reference is made to n values, which corresponds to the polytropic exponent in the pv diagram (see Fig. 1, Part I, p. 111, October), and that the range of n values extends higher than the range of k values for the general run of gases encountered in com-

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Centrifugal Compressor—III

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pressor applications. This is brought about by the fact that the same curves are intended to be used in the calculation of polytropic (or fluid) heads, considered later in this series of articles. Since adiabatic compression is characterized by the fact that $n = k$, it remains only to select a value of n corresponding to the k value of the gas in question to determine $(H_a/T_1) \times$ sp.gr. and, subsequently, the required adiabatic head.

Using the Charts

For example, let us assume that the gas handled is CO_2, with a molecular weight of 44.0 (sp.gr. = 1.52) and a k value of 1.30. Assume further, that the inlet pressure is 14.7 psi. abs., the inlet temperature 85 deg. F. and the desired discharge pressure 80.0 psi. abs. The ratio of compression will be 5.45 and from Fig. 2, we find that $(H_a/T_1) \times$ sp.gr. is 110.5. Solving for the adiabatic head, we get $H_a = 110.5 \times (460 + 85) \times 1/1.52 = 39{,}600$ ft.

As another example, let us assume that the gas handled is methane at 70 deg. F. which is to be compressed from 13.2 psi. abs. to 35.0 psi. abs. Then, sp.gr. = 0.554, $k = 1.316$, $r = 35.0/13.2 = 2.64$. From Fig. 1, $(H_a/T_1) \times$ sp.gr. = 58.0, so $H_a = 58.0 \times (460 + 70) \times 1/0.554 = 55{,}500$ ft.

It goes without saying that the determination of the adiabatic head by means of the curves plotted on Figs. 1 and 2 is much quicker and less tedious than the use of the formula, which requires exponential operations either with a slide rule or with the help of logarithmic tables.

Effect of specific gravity and of the k value of a given gas on the relation between the adiabatic head H_a and the ratio of compression is illustrated in Table I which shows for six different gases both the adiabatic heads required to produce compression ratios from 1.5 to 4.0, and the ratios of compression resulting from various heads from 10,000 to 50,000 ft. The comparison of the tabulated values shows very graphically that whereas an adiabatic head of 10,000 ft. produces a compression ratio of 1.39 for air, the same head produces a 4.5 ratio of compression with Freon 11, a very heavy gas, and a negligible 1.025 with hydrogen which is extremely light. It is therefore impractical to apply a centrifugal compressor for the handling of very light gases such as hydrogen. With this gas, as an example, it is necessary to develop a head of 179,500 ft. to obtain a compression ratio of 1.5 or a discharge pressure of only 7.35 psi. ga. with atmospheric inlet pressure. A glance at Fig. 7, Part I (p. 113, October), will show that such a head is beyond the normal range of centrifugal compressor applications, even when handling very large capacities.

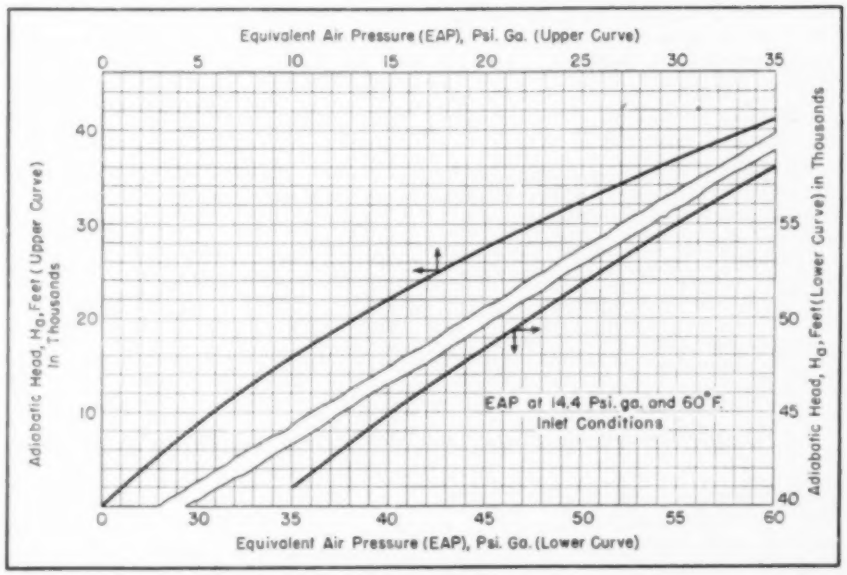

Fig. 3—Equivalent air pressure for air at 14.4 psi. ga. and 60 deg. F. inlet, corresponding to various adiabatic heads

Although the comparison and rating of centrifugal compressors on the basis of adiabatic head is logical and relatively simple, there is still a tendency on the part of both users and some manufacturers to compare them on the basis of Equivalent Air Pressure or EAP. The equivalent air pressure is

Table I—Compression Ratio and Adiabatic Head for Various Gases

Gas	Mol. Wt.	Sp. Gr.	k	Temp., Deg. F.	Compression Ratio, r — Adiabatic Head, H_a, Ft. 1.5	2.0	3.0	4.0	Adiabatic Head, H_a, Ft. — Compression Ratio, r 10,000	20,000	30,000	40,000	50,000
Air	28.95	1.0	1.3947	80	12,450	22,100	37,200	48,900	1.39	1.89	2.49	3.22	4.04
Air	28.95	1.0	1.3947	120	13,400	23,800	40,000	52,600	1.36	1.81	2.35	3.0	3.79
CO_2	44.0	1.52	1.30	80	8,000	14,200	23,600	31,200	1.65	2.56	3.85	5.56	7.9
Nat. gas	20.26	0.7	1.27	80	17,200	30,400	50,400	66,100	1.26	1.59	1.98	2.43	2.95
Butane	58.08	2.0	1.108	80	5,950	10,250	16,600	21,300	1.96	3.65	6.65	—	—
Freon F-11	137.38	4.8	1.135	80	2,490	4,320	7,000	9,090	4.5	—	—	—	—
Hydrogen	2.0156	0.0695	1.408	80	179,500	319,000	540,000	710,000	1.025	1.046	1.07	1.095	1.12

defined as the pressure in psi. ga. which a given compressor would develop at rated capacity and rated speed if it were to handle air under atmospheric inlet conditions of 14.4 psi. abs. and 60 deg. F. Needless to say, such a basis of comparison is purely hypothetical since a compressor designed to handle a gas other than air may not be at all suitable for air compression. Nevertheless the practice exists and it is very simple to construct a conversion chart to determine EAP for any value of adiabatic head, and vice-versa. The relationship between H_a and EAP is based on the fact that for any given value of H_a we can determine the compression ratio $r = p_2/p_1$, assuming the gas handled is air and the temperature 520 deg. F. abs. (60 deg. F.). Then since $r = (EAP + 14.4)/14.4$, the value of EAP for the given value of H_a can easily be determined. The chart of Fig. 3 presents a graphical solution of this relationship for adiabatic heads up to 56,000 ft. and EAP up to 60.0.

Gas Mixtures

While a large proportion of installations involve the compression of air, and while many others may involve that of single constituent gases such as CO_2 or Freon, applications frequently require centrifugal compressors to handle a gas mixture with several constituents. This is the case of compressors handling products of combustion (flue gases) or hydrocarbons such as natural or refinery gas. The composition of these gases may vary within wide limits and since it affects the various characteristics of the gas such as its specific gravity and k value, it is necessary to establish this composition or the specific gravity and the k exponent of the gas rather accurately prior to the selection of the centrifugal compressor for the intended service.

If the chemical composition of the mixture is known, it becomes possible to determine the gas characteristics necessary to compressor calculations through the application of a number of laws and formulas. The derivation of these laws has no specific place in this study as it can be found in any textbook on the subject, but it is advisable to list such of these laws as find frequent application in compressor calculations:

1. Each constituent of a gas mixture exerts a partial pressure determined by the quantity of this constituent, the total volume occupied and the temperature of the mixture, as if the constituent were alone in the space occupied.

2. The total pressure of the gas mixture is the sum of the separate partial pressures of the constituents.

3. The ratio of each partial pressure to the total pressure is equal to the ratio of the volume of each constituent to the total volume as determined by a volumetric analysis.

4. The specific heats, the exponent k and the gas constant R of each constituent of the mixture remain unchanged by the fact that a gas mixture is present. The specific heats, k and R of the mixture can be computed from the corresponding constants of the individual components.

From these laws, the following relations* can be established:

$$MV = m_1v_1 + m_2v_2 + m_3v_3 + \text{etc.}$$

$$G/M = g_1/m_1 + g_2/m_2 + g_3/m_3 + \text{etc.}$$

$$CG = c_1g_1 + c_2g_2 + c_3g_3 + \text{etc.}$$

where M = molecular weight of the mixture; m_1, m_2, etc. = molecular weights of the constituents; G = weight of the mixture; g_1, g_2, etc. = weights of the constituents; V = total volume considered; v_1, v_2, etc. = volumes of the constituents; C = specific heat of the mixture; and c_1, c_2, etc. = specific heats of the constituents.

Properties of Mixtures

An application of these relations is illustrated in Table II which presents the computation of the characteristics of a typical natural gas, the chemical composition of which is known on the volumetric basis. The molecular weight of this gas is found to be 19.75 and its c_p, 0.51991 or, accurately enough, 0.520. Then, its specific gravity is $19.75/28.95 = 0.682$ and $R = 1,544/M = 1,544/19.75 = 78.18$. Finally, $c_v = c_p - R/778 = 0.520 - 78.18/788 = 0.4208$ and $k = c_p/c_v = 0.520/0.4208 = 1.236$.

Should it now be desired to determine the adiabatic head required to compress this gas from an absolute pressure of 14.2 psi. abs. at 100 deg. F. to an absolute pressure of 20 psi. ga., assuming that the atmospheric pressure is 14.7 psi. abs., we can use the gas characteristics we have just calculated as follows: $r = (20.0 + 14.7)/14.2 = 2.44$. Now, from Fig. 1, with $k = 1.236$, $(H_a/T_1) \times$ sp.gr. $= 51.7$ and $H_a = 51.7 \times (460 + 100) \times 1/0.682 = 42,450$ ft.

Once in a while it becomes necessary to determine the adiabatic head H_a corresponding to air pressures around 1 or 2 psi. ga., where the accuracy obtainable from the complete thermodynamic formula is not warranted. A short-cut approximate formula can be used, where:

$$H_a = \frac{\text{psi.} \times 144}{\text{Spec. vol. in lb. per cu. ft.}}$$

Referring the formula to standard inlet conditions for air (14.7 psi. abs., 60 deg. F. and 0.07644 lb. per cu.ft.), we get: (for air) $H_a = 1,884 \times$ pressure in psi. ga., or $117.8 \times$ pressure in oz. Also, since 1 psi. = 27.7 in. of water, then $H_a = 68 \times$ in. of water. If the inlet temperature and pressure deviate from 60 deg. F. and 14.7 psi., a correction is necessary. Then

$$H_a = H_{a\ std.} \times \left(\frac{14.7}{p_1}\right) + \left(\frac{460 + t_1}{520}\right)$$

For gases other than air, the adiabatic head H_a at low discharge pressures can be calculated as shown previously:

$$H_{a\ gas} = H_{a\ air} \times 1/(\text{sp. gr.})$$

Needless to say, this solution, shown in the examples of Table III, is merely an approximation and when more accurate data are necessary, it is recommended to use the method indicated earlier in this article.

Table II—Computation of Characteristics of a Typical Natural Gas

Component	Formula	r, Percent by Volume	m, Mol. Wt.	$r \times m$	Percent G, rm/M	c_p	$c_p \times$ Percent G
Methane	CH_4	0.832	16.04	13.35	0.675	0.593	0.40030
Ethane	C_2H_6	0.085	30.07	2.56	0.130	0.397	0.05161
Propane	C_3H_8	0.044	44.09	1.94	0.098	0.365	0.03577
Butane	C_4H_{10}	0.027	58.12	1.57	0.080	0.351	0.02808
Nitrogen	N_2	0.012	28	0.33	0.017	0.244	0.00415
		1.000		$M = 19.75$	1.000		$C_p = 0.51991$

Table III—Examples of Short-Cut Method

Example 1

Conditions: Gas = Air
Inlet pressure = 14.7 psi. abs.
Inlet temperature = 90 deg. F.
Atmospheric pressure = 14.7 psi. abs.
Discharge pressure = 1.50 psi. ga.

Solution: H_a at 60 deg. F. $= 1,884 \times 1.50 = 2,826$ ft.
H_a at 90 deg. F. $= 2,826 \times (460 + 90)/520 = 2,985$ ft.

Example 2

Conditions: Gas = Carbon dioxide
Molecular weight = 44.0
Inlet pressure = 14.5 psi. abs.
Inlet temperature = 120 deg. F.
Discharge pressure = 17.5 psi. abs.

Solution: H_a air at 60 deg. F. and 14.7 psi. $= 1,884 \times (17.5 - 14.5) = 5,650$ ft.
H_a air at 120 deg. F. and 14.5 psi. $= 5,650 \times \frac{14.7}{14.5} \times \frac{(460 + 120)}{520} = 6,370$ ft.
$H_a CO_2$ at inlet conditions $= 6,370 \times \frac{28.95}{44.0} = 4,190$ ft.

* Reproduced by permission from p. 203, "Centrifugal Pumps and Blowers," by A. H. Church, published by John Wiley & Sons, Inc.

Polymerization of VINYLS

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VARIOUS COMMERCIALLY USED METHODS OF OBTAINING POLYMERIZED VINYL TYPE PLASTICS ARE PRESENTED IN THIS TIMELY REVIEW

With the bulk of today's plastics made from vinyl resins, their processing is becoming increasingly important. Hence, this study of the methods of polymerization and the effects of such factors as temperature and catalyst on the final product will be useful to chemical engineers engaged in this work.

THE GENERAL term "vinyl" is usually associated with such compounds as vinyl chloride, vinyl acetate and vinylidene chloride with the general formula: RCH:CR'R". There are many other compounds that fit into this formula. Among these are styrene, the acrylates, butadiene, and acrylonitrile.

Vinyl compounds may be polymerized by several methods. These are: bulk or cast, solution, emulsion, and suspension or "pearl." In general, all vinyl type monomers may be polymerized using any of the above methods. However, from a practical point of view, the physical properties of the finished polymer and the commercial use to which it is put determine the particular method that is best suited for any given monomer. For example, butadiene and styrene are copolymerized using the emulsion technique. Styrene by itself is usually polymerized using either the suspension or bulk technique.

Oldest Method

Bulk polymerization, a simple method, is probably the oldest method known. It is used today primarily for casting sheets, rods, blocks, and in general, large solid objects of fairly simple design. The monomeric compound is mixed with plasticizer, color, and a small amount of catalyst (usually an organic peroxide) to initiate the reaction. The temperature is kept relatively low, around 40-50 deg C., for as long as necessary to effect the desired degree of polymerization. The main disadvantage with this method is the extreme care required to control the temperature. Since the reaction is exothermic, there must be adequate heat withdrawal either by very good cooling, or by the more generally used practice of permitting the reaction to take place over a long period of time. If this heat is not removed quickly enough, the casting will develop blow holes, cracks, and may even explode. When this polymer is to be used for injection molding, it is milled and then ground into small lumps.

One of the methods of polymerization of vinyl type resins that is used to obtain a material suitable for injection molding is solution polymerization. Vinyl polymers so obtained are also used extensively to make films and thin sheets. In this method, a monomer, methyl methacrylate for example, is dissolved in a suitable solvent such as dioxane, butyl acetate, or acetone. A catalyst is added and the temperature is raised to about 75-95 deg. C. As the polymerization progresses the solution becomes more viscous; however sufficient solvent is present at all times to prevent gel formation. When the polymer has reached the desired degree of polymerization, it may be precipitated as an agglomerate mass by the addition of water or methanol to the solution. The agglomerated mass is then separated from the solvent, dried, and is ready for mixing with color and plasticizer. It may then be extruded or molded. The polymer so obtained is about the purest obtainable, and compares favorably with polymers made by the bulk method.

Emulsion Technique

Polymers made by using the technique of emulsion polymerization are most often used for coating materials, adhesives, and paints. The general process involved in the emulsion method is as follows. The monomer is added to a vigorously stirred solution of water and an emulsifying agent such as soap. An emulsion stabilization agent, which is usually a surface tension depressant or wetting agent, is added with various inorganic salts which act as pH buffers. Plasticizers may be added and then the catalyst. Usually the plasticizer is mixed after polymerization by milling. The catalyst is most often benzoyl peroxide, but may be an alkaline persulphate or hydrogen peroxide. Polymerization is carried out at temperatures between 50 and 90 deg. C.

The polymer obtained by this method is perhaps the most impure, since it contains adsorbed on itself all the compounds, inorganic and organic, used in its preparation.

It may be coagulated by the addition of acid or any other of the com-

mon methods used in coagulating latex and emulsions. However, the polymer made by this method is most generally used in the emulsion form.

Newest Process

Suspension, or "pearl," polymerization is the latest process developed for polymerizing vinyl compounds. Polymers formed by this technique are among the purest, equalling those obtained in the bulk method. They can be used for injection molding and other methods of molding.[8,9] The object of this method is to form discrete beads that may be separated from the forming liquid by settling and filtering. To accomplish this the monomer is strongly agitated in water or an aqueous medium. To this suspension is added a stabilizer which can be easily removed from the surface of the polymer pearl. This may be organic or inorganic and may be a compound such as gelatin, polyvinyl alcohol, bentonite, or talc. To this mixture is added the catalyst (an organic or inorganic peroxide) and the entire mass is heated. The temperature of polymerization is usually kept at least 10 deg. C. below the softening point of the polymer to prevent agglomeration and still provide an accelerated rate of polymerization.

In any of the methods of polymerization, certain definite stages stand out.[1-4,9] The first is activation—conditioning the monomeric molecule so that it will polymerize. This is accomplished by heat, light, catalyst or any combination of the three. It is probably more accurate to consider the activation as the formation of the initiating complex. There is considerable evidence to show that the catalyst is consumed in the polymerization reaction, since fragments have been found in the final product. In the recent patent literature, the use of a single catalyst such as a peroxide, an ozonide, or a metal halide is being discarded in favor of an initiating system composed of both an oxidizing and a reducing agent. The effect of both is combined, producing activated nuclei of polymerization, and maintaining the concentration of these nuclei constant over a given period. This induction period is usually one third of the total polymerization time.

The next step is that of propagation or chain growth. It is usually the simple and rapid addition of monomeric molecules to the "initiating complex." In more complicated cases this step also involves the transfer of the capacity for growth to another monomeric particle.

The third major step in any polymerization reaction is that of stabilization of the molecule or termination of the chain growth. This may be accomplished by mutual saturation of the activated ends, or by collision with solvent molecules or any kind of deactivating impurity.

Some of the most important factors that affect the degree of polymerization and the quality of the product obtained are temperature, heat removal, catalyst, emulsifiers, and solvents.[5,6]

Irrespective of the method of polymerization that is used, increasing either the temperature or the catalyst concentration, or both, increases the rate of polymerization. As this rate becomes greater the molecular size of the resultant polymer becomes smaller. In addition, when the rate of reaction is increased, the problem of removing the heat of reaction and keeping the process under control becomes increasingly important. Another effect of increasing the temperature is to increase the rate of formation of branched chain molecules.[9]

The specific factors that affect the different methods of polymerization are discussed below under separate headings.

Controlling Factors

Bulk Polymerization. Since the reaction is exothermic, the heat transfer rate is the controlling factor. If the heat of reaction cannot be withdrawn fast enough, the polymerization reaction may "run away" causing cracks and holes to appear in the cast plastic.

Solution Polymerization. To a large extent, the solvent selected as the polymerizing medium will affect the size of the polymer molecule.

Emulsion Polymerization and Suspension Polymerization. These two groups are classed together for purposes of this discussion because surface phenomena play a large part in successfully polymerizing a vinyl compound by the use of these methods. In general, therefore, those factors affecting polymerization by the use of one method will affect polymerization when carried out using the second method.

Temperature has a considerable effect on the stability of the emulsoid or suspensoid. Both low and high temperatures tend to prevent the formation of a stable emulsion.

Emulsifiers have a marked effect on catalyst activity. This is probably due to changes in pH of the solution by the addition of the emulsifying agents, which are generally alkaline in nature. As the concentration of monomer increases, the amount of emulsifier that is used must be increased.

Another important factor in emulsion stability is pH control. Not only does pH affect the stability of the emulsion, but it also affects the activity of the catalyst. It may be said generally that slightly acid solutions and those solutions whose pH is above 10 are detrimental to good polymerization and to the stability of the emulsion. Buffers are often used to control the pH around 8.5.

Stabilization of the monomer dispersion is important to the formation of a uniform size of polymer beads. The stabilizer is added primarily to prevent the agglomeration of the dispersed monomer during the polymerization reaction. It acts by forming a non-tacky film on the surface of the dispersed globule. Stabilizers that work with one polymer may not be effective when used with copolymers.

The density of the aqueous medium is also an important factor in suspension polymerization. The higher the density the more uniform the globule size. To obtain a higher density, salt solutions of glycol or glycerine are often used.

The ratio of polymerization medium (usually water) to polymer is of little importance in the reaction. However, sufficient water, or similar non-solvent, must be present to absorb the heat of reaction. The usual amount is three to six times as much water as monomer.

Depending on the nature of the stabilizer and the final percent conversion of the monomer, the globules of polymer may vary from water white to white opaque. The pH of the reacting medium has a definite influence in the case of bead formation. A pH from 7 to 10 makes the most favorable condition for polymerization.

Many Patents

There have been, as mentioned previously, a large number of patents issued on the methods of polymerization and the catalysts and stabilizers that may be used. In recent years, most of them have concerned themselves with emulsion techniques, and to a lesser extent, with bead and solution method.[10-35]

One technique for emulsion polymerization of vinyl esters has been described[31] using the following formula:

Aerosol O. T. (emulsion stabilizer)	0.01 percent
Emulsifying agent	1
Water	50
Monomer	50
Catalyst	0.50
Temperature	60–90 deg. C.

The emulsifying agent and emul-

sion stabilizer are dispersed in the water. This is stirred while the vinyl monomer is added slowly, followed by the catalyst. The mixture is then heated to reflux gently and held there for two hours.

The emulsifying agent is a protective colloid which will be stable from 0 to 90 deg. C. and usually contains several colloids having complementary stabilizing properties. There may be:

Methyl cellulose plus gum tragacanth	2:1
Methyl cellulose plus potato starch	1:1
Hydrolyzed polyvinyl acetate with 40 percent acetate plus hydrolyzed polyvinyl acetate with 10 percent acetate	1:1
Hydrolyzed polyvinyl acetate with 40 percent acetate plus gum tragacanth	2:1
Hydrolyzed polyvinyl acetate with 33 percent acetate plus potato starch	1:1

The catalyst is a peroxide such as H_2O_2 with $NaHCO_3$ as an accelerator and acetaldehyde added as a moderator to control the reaction and to form a polymer emulsion of a predetermined viscosity. For high polymer viscosities, small amounts of peroxide (0.04 percent) together with 0.1 percent $NaHCO_3$ are used. For polymers of smaller molecular size, high catalyst concentrations of the order of 0.1 to 1 percent are used and 0.6 to 6.0 percent acetaldehyde must be used for controlling the reaction.

In another method "for emulsion copolymerization of vinyl chloride and vinylidene chloride, we find the use of a buffer such as Na_2HPO_4 and citric acid, or NaOH and KH_2PO_4, or NaOH and H_3PO_3 to keep the pH of the emulsion above 6.5. The oxidizing catalyst suggested may be H_2O_2, NH_4ClO_4, $KMnO_4$, $Na_2S_2O_8$ or $NaBO_3$. The temperature for the reaction is between 25 and 50 deg. C.

Mesityl oxide when used as an addition solvent in a solution polymerization of vinyl aromatic compounds such as styrene produces polymers of lower molecular weight.[24] Its chief effect is in concentrations of from 0.5 to 15 percent by weight of the total mixture. Organic solvents like benzene or ethylbenzene may be used in polymerizing these compounds by the solvent method. An aqueous solution containing at least 65 percent of $ZnCl_2$, $ZnBr_2$ or ZnI_2 is recommended in another formula[25] as being a suitable medium for carrying out a bead polymerization of vinyl esters.

Interpolymers of vinyl esters with modified drying oils[26] may be made using as a catalyst benzoyl peroxide. Tung oil or other frosting drying oil is heated with methyl methacrylate in the presence of benzoyl peroxide. This product is then interpolymerized with monomeric vinyl acetate to form a polymer which dries rapidly to a hard, tough, glossy surface free from frost.

Catalysts

The literature contains references to many substances that may be used as catalysts either singly or in combination with a promoter. They are all oxidizing chemicals and may be organic peroxides such as benzoyl dibutyl, dicaproyl, and dicaprylyl.[27] Hydrogen peroxide either by itself or in admixture with ferric compounds or sodium hydroxide is a favorite catalyst. Ammonium perchlorate, sodium thiosulphate, sodium borate, alkaline metal persulphates, alkaline earth persulphates and sodium sulphite or bisulphite in combination with sodium ferric phosphate have all been used to catalyze the polymerization of vinyl compounds.[19, 23, 24, 28] Each of these catalysts affects the polymerization reaction to a somewhat different degree. Some are more active, resulting in more rapid polymerization and shorter chain lengths. Others cannot be used in emulsion or suspension polymerization as they affect the stability of the emulsion or permit agglomeration of the beads during polymerization. It has been found, in general, that catalysts which are soluble in the monomer are somewhat more effective. In any case the concentration of catalyst is usually in the range of 0.1 to 1.0 percent of the monomer weight.

Emulsifying agents and emulsion stabilizers are equally as numerous or perhaps more so than are catalytic materials. The emulsifying agents are generally soaps, surface active agents such as Aquarex D, Kekal, or higher esters like monoethylene glycol (mono) stearate. Emulsion stabilizers may be either a surface tension depressant or an inorganic chemical added to buffer the pH of the solution. Suspension stabilization may be accomplished in two ways. One is to adjust the density and the viscosity of the suspending medium so that the suspended globules of monomer will tend to remain separated. The other method is to add such materials as colloids or soluble high polymers like polyvinyl alcohol, talc, gelatin, gum tragacanth, bentonite, or magnesium carbonate.[8,9]

It may be concluded that in polymerizing any vinyl compound, considerable thought must be given to the desired product and its uses. Perhaps the best method of solving this problem is by testing and experimenting, using as a guide the general principles presented here.

References

1. R. E. Burke, B. G. Baldwin and C. H. Whitacre, *Ind. & Eng. Chem.*, **29**, 326 (1937)
2. C. C. Price and R. W. Kell, *Journal ACS*, **63**, 2798 (1941)
3. H. N. Aleya, J. J. Gartland, H. R. Graham, *Ind. & Eng. Chem.*, **34**, 458 (1942)
4. C. C. Price, R. W. Kell, and E. Krebs, *Journal ACS*, **64**, 1,103, (1942)
5. R. Gineli and R. Simha, **65**, 706, 715 (1943)
6. C. F. Fryling and E. W. Harrington, *Ind. & Eng. Chem.*, **36**, 114 (1944)
7. R. E. Burk et al. "Polymerization and its Application in the Fields of Rubber, Synthetic Resins and Petroleum—" A.C.S. Monograph 75, Reinhold Pub. Co., New York (1937)
8. W. P. Hohenstein, Polymer Bulletin, **1**, 13-16, Interscience Publishing Co., New York, (1945)
9. W. P. Hohenstein, F. Vinguello, and H. Mark, *India Rubber World*, **110**, 291-4, 300 (1944)
10. U. S. Pat. 2,379,251
11. U. S. Pat. 2,348,154
12. U. S. Pat. 2,356,925.
13. Belgian Pat. 446,430
14. U. S. Pat. 2,349,136
15. Britain Pat. 555,569
16. U. S. Pat. 2-359,156
17. U. S. Pat. 2,366,306
18. Britain Pat. 557,159
19. U. S. Pat. 2,345,659; and 2,345,660
20. U. S. Pat. 2, 346, 358
21. German Pat. 735,284.
22. German Pat. 736,184.
23. U. S. Pat. 2,296,403
24. U. S. Pat. 2,296,837
25. U. S. Pat. 2,299,862
26. U. S. Pat. 2,301,368
27. Britain Pat. 545,703
28. U. S. Pat. 2,333,633.
29. U. S. Pat. 2,326,736
30. Britain Pat. 562,956
31. U. S. Pat. 2,388,600-602
32. U. S. Pat. 1,942,531
33. Canada Pat. 348,471
34. Canada Pat. 352,766
35. U. S. Pat. 2,011,132

Ammonia Liquor Used as Fertilizer

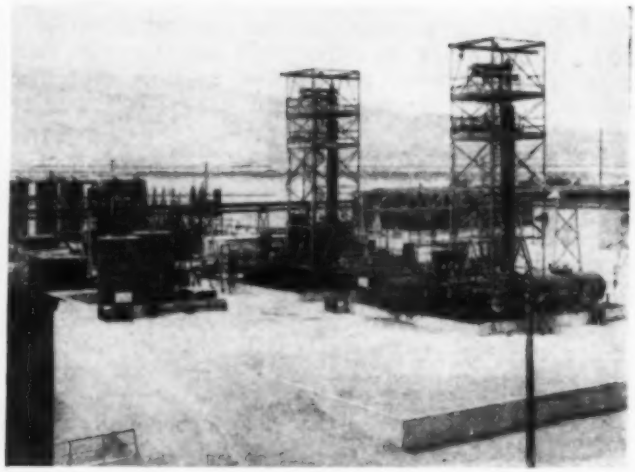
FARMERS around Verdun, Germany, have found an effective fertilizer in the ammonia liquor given to them by the local gas company. Quantities of sulphuric acid normally used to convert the liquor into commercial fertilizer are saved according to a report, "By-Product Ammonia Recovery,"* available from the Office of Technical Services.

When sprayed on test plots of ground between September and May, the liquor increased the yield of grain and root crops—in some cases as much as 2½ times. Farmers have been using the ammonia liquor for several years although conversion to the sulphate has been continued at the larger gas works and in localities where the liquor could be collected and processed in a central plant.

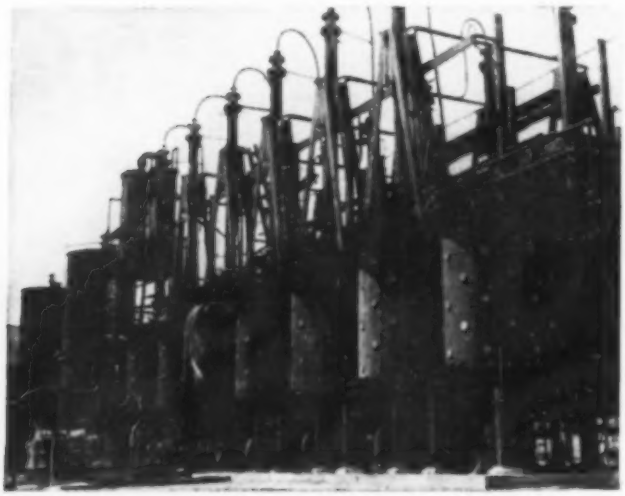
The report, prepared by the British Intelligence Objectives Sub-Committee, gives information on present German methods of concentrating and converting ammonia liquor.

* PB-63698 "By-Product Ammonia Recovery," photostat, $2; microfilm, $1; 16 pages. Order from OTS, Department of Commerce, Washington 25, D. C.

IN 1944 this magnesium plant at Henderson was shut down



NOW magnesium plant is divided into several chemical plants

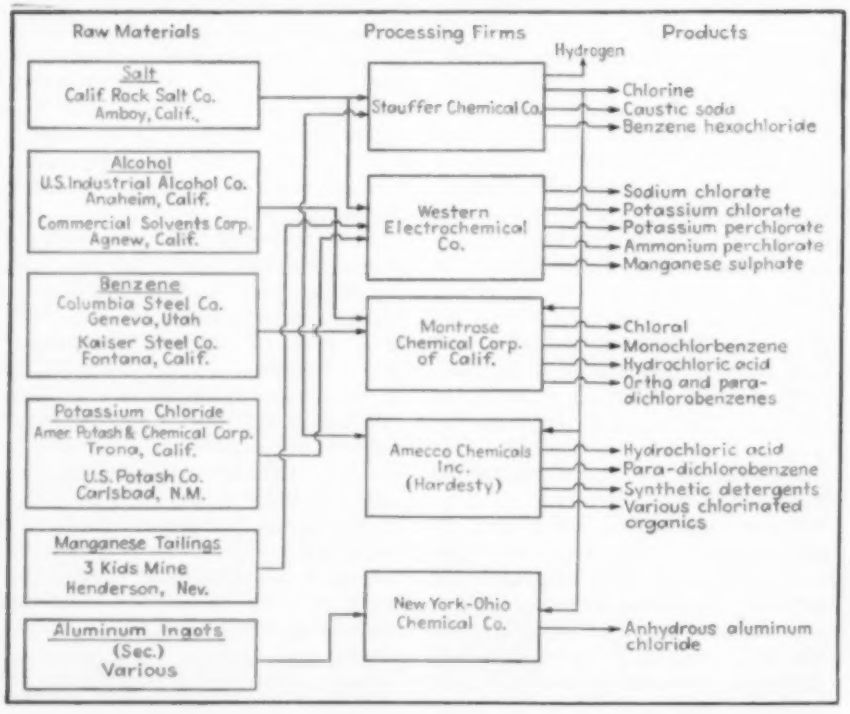


NOW Montrose uses part of plant for making chemicals

The Story

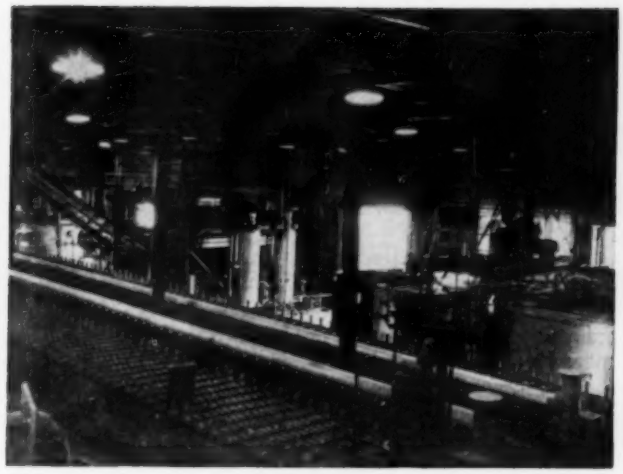
T. B. GIBSON
Stauffer Chemical Co., San Francisco, Calif.

That great magnesium plant near Las Vegas, which only a government could build and finance, looked quite ghostlike when the war came to an end. From it has sprung an interesting group of chemical industries including plants of the Stauffer, New York-Ohio, Montrose, Amecco, and Western Electrochemical companies. There is not and probably never will be a local market for the products. But the site has many advantages for the process industries such as availability of ready built facilities, cheap housing, a warm dry climate, access to plentiful water, power, chlorine, caustic, hydrogen and mineral raw materials.



◀ Already such chemical plants as these have sprung up at Henderson and others will follow. It is logical that this area may be a "factory district" for chemical consuming areas of Los Angeles, San Francisco Bay, Pacific Northwest and Salt Lake

NOW New York-Ohio makes $AlCl_3$ in a section of wartime plant



NOW Western Electrochemical makes chlorates, perchlorates

# of Henderson, Nevada

FROM THE REMAINS OF THE GIANT GOVERNMENT PLANT SPRINGS AN INTERESTING GROUP OF CHEMICAL PLANTS

THE GIANT government magnesium plant at Henderson, Nev., was built at a cost approximating 130 million dollars and operated from August 1942 until November 1944, turning out as high as 10 million pounds of much needed magnesium per month. The site at Henderson was selected because of its central location between the magnesite ore supply at Gabbs, Nev., to the north and the salt supply at Amboy, Calif., to the west, and because power and water were available from Hoover Dam, and rail transportation at Las Vegas.

Anaconda Subsidiary

Built for the government by Howard Eells' Basic Refractories, operations were taken over by Basic Magnesium, Inc., a subsidiary of the Anaconda Copper Co. in the fall of 1942. The plant is situated on a tract of land of 18,000 acres, and consists essentially of facilities and equipment to (1) receive, store, blend and pelletize magnesium raw materials; (2) chlorinate pelleted material to produce anhydrous magnesium chloride (includes 200 plus ton chlorine-caustic plant); (3) electrolyze the chloride to produce unrefined metallic magnesium; (4) refine this "cell metal" to marketable magnesium and its alloys. There are also plants to prevent the escape of noxious fumes recovering magnesium chloride and hydrochloric acid and to produce fluxes for refining molten magnesium. There are some 60 major buildings plus hundreds of smaller ones.

The magnesium plant was shut down in November 1944 but because of the continuing demand for chlorine, the chlorine-caustic unit continued to operate. In early 1945 the Defense Plant Corp., wishing to relieve itself of the responsibility of operating the plant, commenced preliminary negotiations with several large chemical firms to take over this unit and operate it on a management fee basis. The Stauffer Chemical Co. had, prior to the war, a substantial caustic soda business in southern California supplied by their lime soda process plant at Dominguez, Calif. During the war WPB requested the discontinuance of this operation in order to divert soda ash into other defense production. The Stauffer company became interested in this Henderson unit and entered into negotiations to lease the plant. These negotiations were successful and a lease was signed with DPC whereby on May 21, 1945, Stauffer took over the operation of this unit on a rental basis.

Other Henderson Plants

At this time the Rheem Manufacturing Co. was operating a shell loading plant there and the Western Electrochemical Co. was getting ready to manufacture chlorates and perchlorates. At this time also, J. M. Montgomery Co. took over the management and upkeep of the BMI facilities for the government. Stauffer, realizing that it was not economically sound to ship chlorine East, undertook with the aid of the government and the Montgomery people, to induce chemical manufacturers, especially users of chlorine, to establish plants at Henderson.

The New York-Ohio Chemical Co soon built a plant for the manufacture of anhydrous aluminum chloride. The Hardesty Chemical Co. (recently purchased by Amecco Chemicals, Inc.) commenced the manufacture of chlorinated organics and a synthetic de-

tergent and in the spring of 1947 the Montrose Chemical Co. of California undertook the manufacture of chloral and of monochlorobenzene for their DDT plant at Torrance, near Los Angeles. Hydrochloric acid, para- and ortho-dichlorobenzene are recovered as byproducts, the first being used by U. S. Vanadium Corp. in their operations.

The U. S. Vanadium Corp., a subsidiary of Union Carbon & Carbide Corp., in order to centralize their operations, located their refining plant there for processing tungsten ore from the Winnemucca mine and from other western prospects. In addition they undertook the manufacture of ammonium tungstate. In the fall of 1947 these operations were transferred to Bishop. It is stated, however, that they will retain their lease for another operation.

Largest Chlorate Plant

The Western Electrochemical Co., producers of chlorates and perchlorates at Los Angeles, had taken over a portion of the Basic facilities in June of 1945. After a short shutdown following the end of the war with Japan, operations at Henderson were resumed and expanded until it is now the largest chlorate plant in the world, producing sodium and potassium chlorates and potassium and ammonium perchlorates. The government's accelerated rocket program is the major consumer of potassium perchlorate. Potassium chlorate is used chiefly in the manufacture of matches. Both of the above products find ready export markets. The production of these four compounds is now about 1,000 tons per month at Henderson. Another division of Western Electrochemical Co. produces manganese sulphate from a stock of partially refined ores at the 3 Kids Mine located at Henderson. It intends to continue this operation using fresh manganese ore when the present stockpile is exhausted.

During the spring of 1947 the Guy F. Atkinson Co. took over from J. M. Montgomery Co. the management and upkeep of the BMI facilities.

On June 1, 1947 Stauffer opened up 150 additional cells to supply the demand for more chlorine and caustic. In October 1947 this company signed a long term lease with the RFC which includes an option to purchase and provides for four 5-yr. renewable terms; rental is based upon a percentage of sales of both chlorine and caustic soda.

In October 1947 the WAA offered the whole BMI project, including the housing, to the State of Nevada through its Colorado River Commission for $1 down with the balance paid over a period of years out of earned revenue. This is a prior offer to negotiate and remains open until Dec. 31, 1947. It is felt that the State of Nevada will be in a preferred position to obtain plentiful cheap electric power for the lessees at Henderson.

New Insecticide Unit

In February 1948 a plant for the manufacture of benzene hexachloride, the promising new insecticide especially effective for cotton pests, will be placed in operation by Stauffer.

Other firms presently located there are Nevada Clay Products Co., Sears Roebuck Co., Coulter-Harden & Co., Mineral Materials Co., Western Mineral & Development Corp., and a group of firms leasing warehouse or office space.

Henderson has no local markets for the products of chemical plants (excepting other plants located at BMI) and probably never will have, at least for many years. Rainfall there is almost nil except in the mountains at altitudes above those at which crops would grow. The lack of vegetation makes the land subject to wind and flood errosion; it is barren, rough, covered with dry washes, gravel beds and contains salt encrusted valleys, or "sinks."

No Eastern Markets

There is nothing except the plant to attract population or support it. Thus chemicals produced here must be "exported." A car of chlorine shipped East will return to the manufacturer only a fraction of its cost if sold "freight allowed" to compete with eastern producers' $45 a ton price. Therefore markets in the eastern area are "out" during normal competitive conditions.

That leaves only the industrial (or chemical consuming) areas of Los Angeles, San Francisco Bay, Pacific Northwest and Salt Lake which can be reached more advantageously from Henderson than from the East. San Francisco is competitive with Henderson for Salt Lake, and to a certain extent Los Angeles, and has a marked advantage in shipping into the Pacific Northwest. Los Angeles will probably develop to be its primary market, Salt Lake a small secondary market, San Francisco, Pacific Northwest and possibly Texas highly competitive markets that may be successfully invaded only by products having a higher than average value, or a major portion of their cost being electrical power. Eastern and foreign markets will only be available to production of a special nature or having a very high value. While it is probable that certain existing freight rates may be altered to a more equitable basis it is highly unlikely that such adjustments will materially affect the economics at Henderson.

It might be pointed out here that Los Angeles sentiment seems to be against a great local concentration of heavy industries. Recently a number of ordinances have been passed which severely regulate smoke, fumes and industrial wastes and it appears logical that Henderson become the "factory district" of that area.

Advantages

The site has a number of important advantages for chemical and allied products manufacture, among which are the availability of ready built facilities, cheap housing, a warm dry climate which permits the installation of certain types of equipment out of doors, access to plentiful inexpensive water, power (which will be discussed later), chlorine, caustic soda and hydrogen (now produced there), and certain mineral raw materials. Also the problems of waste disposal, smoke, soot, dust and fumes are not encountered here. To exemplify the use of out-door installation it may be said that the Montrose Chemical Co. has here erected its chlorinators, condensers, stills, absorption towers, tanks, etc., for the manufacture of chloral and monochlorobenzene out of doors, thus saving the investment in a building for the protection of its equipment against the weather. Water is available from Lake Mead by means of a 40-in. welded steel water pipeline with reservoir and water treatment plant at Henderson. Chlorine is available either as cell gas or in liquid form; caustic soda is available at present only in liquid form, and hydrogen gas, limited in amount by the saleability of chlorine, is available at very low prices.

Power

At present power is costing the lessees at Basic between 4 and 5 mills per kwh. and is being supplied by the Southern California Edison Co. Back in 1946 the State of Nevada, through its Colorado River Commission contracted with Southern California Edison, the Los Angeles Bureau of Light

& Power and the Metropolitan Water District of Southern California to sell them the surplus from its allocation of Hoover Dam power for a 5-yr. period. It is understood that these southern California groups have now agreed to renegotiate those contracts. The State of Nevada eventually will be able to offer power at about 2 mills from its allocation of Hoover energy. Davis Dam, 50 mi. down the river, will be completed in about three years and will furnish standby power.

Committee Recommendations

Last August the Senate Special Committee to investigate the Defense Program and the Sub-committee on Surplus Property of the Committee on Expenditures in Executive Departments held hearings in Las Vegas and in Washington, D. C. A joint report recommends that Basic lessees be furnished interim power at approximately 2 mills from the Nevada block of energy now going to Los Angeles and southern California. The committee stressed that industries locating at Henderson must have low cost power for chemical, electrochemical and electro-metallurgical production. It recommends that transmission facilities be transferred to the Bureau of Reclamation and operated under one head; that Nevada be allocated one-third of the Davis Dam power; and suggests that the cost of Davis Dam power be held at 3 mills or possibly 2½ mills per kwh. in order that the Basic Magnesium project and the power transmission facilities may be brought into full peacetime use, and still be permanently available in case of war.

Raw Materials

Raw materials and ores available in the immediate area include magnesium, manganese, tungsten, lead, zinc, colemanite (borax ore), which could possibly be used as the basis for boric acid manufacture by treatment with sulphur dioxide or perhaps by electrolysis—these processes are both experimental so far—gypsum, clay, bentonite, silica, limestone, fluorspar, barytes, brucite, diatomaceous earth, talc, soda ash, salt and coal (sub-bituminous, of a fair quality convertible to coke). In addition coal tars from Geneva, Utah, may possibly be available before long and the enormous phosphate rock deposits of Idaho, Wyoming, Montana and Utah offer the possibility of manufacturing elemental phosphorus here by the electric furnace process.

Present Operations

The 200 plus-ton chlorine-caustic soda plant presently leased to Stauffer includes the following major buildings and equipment: two cell buildings—protected metal on structural steel, concrete floor construction, each containing 450 Hooker Type S cells (only 150 of which are completely hooked up in the second building), traveling cranes, etc. A two story caustic evaporation building—corrugated asbestos cement sheets on structural steel frame construction containing six Swenson evaporators, three ammonia ice machines, various filters, heat exchangers, etc. Two chlorine liquefication buildings—four stories, protected metal on structural steel frame, each containing ceramic chlorine coolers, four Nash turbines, four Ingersoll Rand ice machines, compressors, condensers, etc. The rectifier buildings—two-story reinforced concrete construction each containing six Allis Chalmers single tank multiple anode rectifiers, three large 5,970 KVA. and three small transformers, air and oil circuit breakers, control panels, etc. Sub-station buildings, two hydrogen houses, a cell renewal building, concrete parts building, warehouse and foundry building, office building and miscellaneous smaller structures; 17 tanks for brine storage and handling; two 175,000 gal. oil storage tanks; eight 150,000 gal. caustic storage tanks; two 160,000 gal. cell liquor tanks. Stauffer also has laboratory space in the main laboratory building.

New York-Ohio Chemical Co. facilities for the production of 7½ tons per day of anhydrous aluminum chloride are located in a portion of building B-2. Principal pieces of equipment include ten reactors and condensers, crushing, conveying and screening equipment, etc.

Montrose Plant

The Montrose Chemical Corp. of California plant is located on ground subleased from Stauffer just west of cell building No. 2. The equipment is not housed and consists essentially of chlorinators, and condensers, chloral stills, condensers, and receivers, a monochlorobenzene mixing tank, two benzene chlorinators and condensers, two stills for vacuum distillation of chlorinated benzene, washing and settling tanks, two muriatic acid absorption towers and a Karbate heat exchanger plus storage tanks and miscellaneous pumps etc.

Amecco Chemicals, Inc., occupies one of the large metals buildings; it is of reinforced concrete and structural steel framing construction with concrete and quarry tile floors. The company manufactures various chlorinated organics, synthetic detergents, chemicals for fireproofing paints, insecticides and chlorinated solvents. Headquarters and sales offices have been transferred here from the East and the management has indicated it intends to expand into new processes and products to keep pace with the growing needs of the West.

Western Electrochemical Co.

The Western Electrochemical Co. occupies metals units D-3 and D-4, the former being used for warehousing and the latter housing the electrolytic cells and other production equipment for chlorate and perchlorate manufacture. There are ten 1,850 kw. mercury arc rectifiers converting the Boulder current from alternating to direct. The cells are connected in series to make 350-v., 5,000-amp. circuits. The Schumacher type chlorate cells are rectangular in shape and are provided with iron cathodes and graphite anodes, but do not have diaphrams.

Electrolyte Circulation

Circulation of the electrolyte is maintained by a centrifugal pump. The discharge side of this pump is connected by a manifold which feeds each cell individually. Electrolyte which overflows from the cells is handled in a similar manner by means of a second manifold which conducts the electrolyte back to an intermediate sump which supplies the circulating pump, thus maintaining continuous circulation. The Schumacher perchlorate cells are similar in design and operation but about one-third the size and equipped with platinum instead of graphite anodes. Glass piping is used wherever possible in order to get away from the serious corrosion problem, and where glass was not practical Duriron or ceramics was used. (See *Chem. and Met.*, Dec. 1944, p. 108-109 and 130-133.)

Manganese sulphate operations are conducted in the salt storage building B-4 to the north of the chlorate plant. The company also occupies and uses the railroad loading platform, a change house, salt storage tanks and an office building, all adjacent to their main plant.

The author wishes to acknowledge the assistance of Joseph C. Schumacher, Western Electrochemicals Co., and T. Ross, Stauffer Chemical Co., in the preparation of this article.

EDITORIAL VIEWPOINTS

Sidney D. Kirkpatrick and Staff

SENSE AT LAST

For more than a year State Department officials have been struggling against the inevitable. At last they admit officially to the Senate Committee on Foreign Relations that they intend to ask nations which need our aid to pay for part of the assistance which we give in strategic and critical materials which we want.

This is a belated recognition forced on the diplomats by the joint pressure of business men, legislators, and the military. One may suspect that Secretary Marshall has long supported the idea, but has not until lately overruled the "striped pants" element which still remains in the department.

One of the most fallacious arguments regarding getting these strategics is one which reached even a high position in White House thinking. We refer to the thought that demanding strategic materials both for our industry and for the government stockpile might seem "provocative" to other nations. Some diplomats were so silly as to state that it was their belief that we should not ask for these materials lest it appear that we were getting ready for another war.

Private enterprise now has a dual job to do. It must continue to press for the practical application of this principle. There is danger that the good intentions of some may not be realized in the actual receipt of wanted goods unless the matter is continually pressed by informed industry.

In the second place, industry must see to it that commercial purchasers have a chance to get a part of the imports. Some will go into the government stockpile. But all must not go there. Once in the stockpile, they can be withdrawn for use only in the case of war. The working reserves of industry are very low in the case of many needed commodities. Industry should get part of the repayment in a manner that builds up to a sound working level the goods reserves of all parts of business affected.

Let us welcome the new policy, but also tend the two jobs that still need to be done.

BEFORE YOU TELEGRAPH

Congress is back in special session. It will resume normal regular session proceedings early in January, probably to stay for five months. During this time there will be demands from many that industry spokesmen telegraph their Congressmen for or against some cause, for or against some bill.

There are times when this action should be taken. But it is too easy to be stampeded into action of this sort when some particular clamor arises.

Vastly more good can be done if engineers and executives will consciously study the problems of importance to them before Congress reaches a crisis. Then the influence of the proper spokesmen can be brought on the proper legislators in a way that will be far more helpful and effective. Congressmen get so many telegrams that they have relatively little effect. They get far too few carefully studied recommendations and criticisms of proposed legislation. In most cases they welcome a conference with carefully prepared people who know what they want and why they are entitled to get it.

Civic responsibility can be served best by careful rather than commotional proceedings.

WORTH STRIKING FOR

Fred Willkie, chemical engineering vice president of Joseph E. Seagram & Sons, Inc., can always be counted on for thinking and acting in advance of the crowd. His employment and training policies for technical personnel, now universally hailed as most constructive, were once condemned as a radical undermining of professional status and standards. His latest book "A Rebel Yells" (Van Nostrand, 1946) proved equally disturbing to industrial management in many fields. Now comes an article in the current issue of Factory in which able Manager Willkie tells Labor that its strikes have only scratched the surface in solving its real problems in an industrial society. He cites a half dozen new types of strikes that might well prove more popular than the purely mercenary.

First of these unusual strike motives is the protection of the public against an employer who fails to deal honestly and fairly with his customers in maintaining quality and reputation of his work. Second would be a strike against regimentation, whether that pyramiding of power came from the employer or from the labor union itself in the form of undue economic pressure or threat of violence. This, of course, would imply the secondary obligation to strike against a strike by those workers who are forced to follow principles and practices with which they do not agree.

Motive No. 3 gets at labor's vested interest in whether or not the job is being done right—i.e., with proper industrial efficiency. Mr. Willkie holds that labor must not only be made to see that its own self-interest lies in improved mechanization but the workers should believe in it so thoroughly as to be willing to strike against an employer who refuses to adopt modern methods and machinery. Closely related is the fourth in the series, the willingness for workers to strike for further training and education within their own industry when blocked in the opportunities to grow and develop in their jobs.

Other public-interest motives, which might be recognized as proper and well founded in an ideal democratic

industrial society, include the right to strike against shoddy raw materials, against featherbedding on the part of either labor or management, against prices that are out of reach of the consuming public. Willkie holds that labor should fight compulsory arbitration with all its strength for in that direction lies the freezing of workers to jobs, the stagnation of job development and the end of industrial progress.

Knowing the author as we do we suspect that he did not expect to have his ideas accepted—at least not immediately—by either labor or management. But this sort of leaven in the loaf provides the lift we all need occasionally to get away from soggy thinking on labor relations. Some day we may expect to read about strikes that were not prompted primarily by mercenary motives.

DATA FOR BOSSES

EVER since we published an editorial last April (entitled "Data for Boss-pickers") we have been flooded with requests for copies of the final report of the Engineers Joint Council Committee on the 1946 Survey of the Engineering Profession. At long last we have our copy and, in our opinion, it is well worth waiting for. For the first time, we have an accurate statistical analysis of economic factors as they are shown to affect the qualified members of the engineering profession. And since these questionnaires were confined to the six principal engineering societies, the professional status of every person included in the survey is amply attested. This is one feature that makes this report particularly valuable.

Another is that it was compiled under the official auspices of the U. S. Bureau of Labor Statistics by an experienced staff headed by the same Andrew Fraser who contributed so much to the earlier surveys of chemical workers sponsored by the Economic Status Committee of the American Chemical Society. The American Institute of Chemical Engineers was smart in selecting as its representative on the EJC Committee the same Lawrence W. Bass who had guided both the 1941 and 1944 studies for the ACS. From such experienced hands has come a 100-page fact-packed document that will be studied intently by all concerned with the engineer's status and stake in the national income. We suspect that the bosses will use it more than the boss pickers but every engineer should have a copy. If not a member of one of the national engineering societies, your check or money order for one dollar should go to the Secretary of the Engineers Joint Council, 33 West 39th St., New York 18, N. Y.

INDUSTRY'S CINEMATIC AMBASSADORS

TWO SUCH apparently unrelated things as Britain's austerity program and our State Department's "Voice of America" operations have provided alert publicists in the chemical process industries with two new opportunities to sell the American industrial way of life abroad. This can be accomplished by release now for foreign bookings of short industrial movies such as are frequently shown to employees and to scientific and technical societies.

First of the new opportunities is in the United Kingdom, where U. S. commercial movies have recently suffered a setback. Britons, deprived by their government's austerity program of their usual Hollywood film fare, will probably be very happy to see such industrial "shorts" as American concerns may wish to release in the "tight little isle."

Second opportunity is through the State Department's "Voice of America" activities. The Department seeks to improve understanding of America in other countries by circulating films dealing with American life.

How industrial America lives and works, told in simple, documentary fashion in industrial movies, can do much to re-educate Europe's unfortunates who have been living behind the curtain of war. Eager to learn about democratic free enterprise in the fabulous United States and feeling a kinship with American workers, these people will be eager to see what makes the wheels go around in our factories, what tools and machines our workers use, how our workers earn and spend their wages and how they live.

While the educational features of such a program should be uppermost in the minds of chemical management at present, let it not be forgotten that stimulation of demand for American goods will be a valuable byproduct of such public relations work. Dollar-hungry Europe may now defer such demand, but eventually it will be felt in the market.

SELLING AGAIN!

FOR two reasons there is continually increasing need for better selling of chemicals, and to some extent for selling of chemical machinery. Supplies are getting more nearly equal to demand, of course more so in the case of chemicals than machinery. But more important is the need for selling to bring new developments to the attention of prospects who have not been able to keep up with the many changes resulting from research.

This need for selling is not unwelcome. Especially in well-organized sales groups it restores the feeling of a job to be done. It is fortunate that merit and not mere order-taking may again be recognized and rewarded.

SALARY CEILINGS

CHEMICAL process industries have a new chance to learn a lot from personnel proceedings in Washington. Uncle Sam has recently advanced a few selected scientists to salaries of $15,000 per year. Thus a new salary ceiling has been set.

"Why should I stay with my present employer?" This is a logical and a likely question of young technical employees in both industry and government. And the brighter the young man, the sooner he will think of it.

One wonders how many top executives in either research or operation have consciously studied the meaning of this question. Unless the question is studied, and a sufficiently attractive future is made visible to the young man, one can not expect him to remain long in his present position.

With the scarcity of real talent in both science and engineering likely to continue for five or more years, this should be made of first concern to every technical management. It is likely to remain a problem of large importance even through times of minor recession. Ignoring the question until hard times come is unwise.

THE PLANT NOTEBOOK

Theodore R. Olive, ASSOCIATE EDITOR

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. The winner each month will be announced in the issue of the next month: e.g., the December winner will be announced in January and his article published in February. Judges will be the editors of *Chemical Engineering*. Non-winning articles submitted for this contest will be published if acceptable, in that case being paid for at applicable space rates.

Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are considered.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

NOVEMBER WINNER

A $50 prize will be issued to

H. W. HEISER
Aluminum Ore Co.
East St. Louis, Ill.

For a description of a modified air lift for agitating heavy slurries, regardless of variations in liquor level, which has been judged the winner of our November contest.

This article will appear in our January issue. Watch for it!

October Contest Prize Winner

CHART READING AND DRAFTING SPEEDED BY PROPORTIONAL INTERVAL DIVIDER

R. B. BENNETT
Firestone Tire and Rubber Co., Akron, Ohio

AN OPERATION which is quite common in making and reading graphs and drawings is the dividing of a line into proportional parts. If many of these operations are necessary, as in perspectives, logarithmic and triangular charts, much time is wasted. A simple instrument easily constructed from sheet plastic, cardboard or metal can save much of this time.

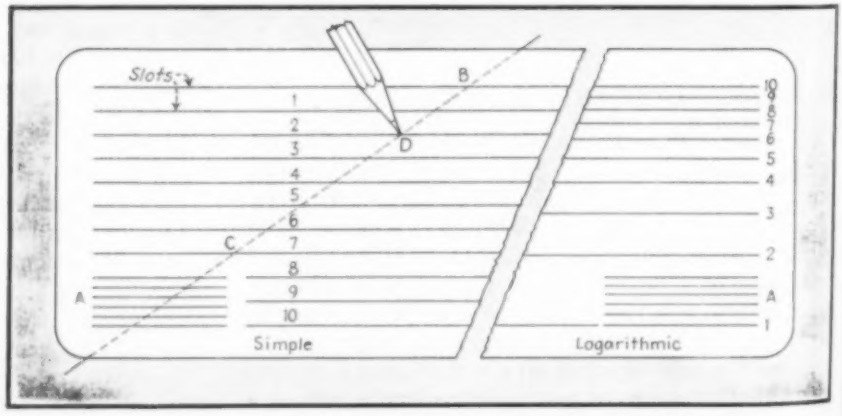
The principle of this instrument is familiar to every engineer, since the commonest method of dividing a line into x spaces is to hold a ruler at a suitable angle to the line, then carry back the desired number of divisions by "similar triangles." The novel feature shown here is that the instrument eliminates the need for drawing a number of parallel lines.

Shown in the accompanying sketch are two variations of this idea. They are superimposed for space saving, but each would be made in approximately the same overall proportions as is indicated by the outline for the two. A convenient size would be 6 x 2½ x $\frac{1}{16}$ in. thick, or somewhat thinner. At the left the diagram labeled "simple" shows the type for linear division of lines, while the portion at the right, labeled "logarithmic" indicates how a logarithmic divider is made.

Either kind can be marked on plastic or other suitable material and then slotted with a router or knife to form a series of parallel V-shaped slots just wide enough to admit a pencil point.

Use of the linear type is shown with the line *CB* on the left-hand section of the diagram. The plastic sheet is laid over the line with position *B* beneath one slot. If the line is to be divided into seven parts, then the divider is rotated until C appears in the seventh slot. The six intervening slots are then used to mark the divisions. Long lines can be divided first into equal parts spannable by the instrument, while short lines can be divided into smaller sections as at *A*.

The logarithmic variation is used similarly. *A* in this case can be cut to smaller divisions of the same cycle (as shown) or it can be cut to give a smaller cycle. Only those who have worked with logarithmic graphs can appreciate the trouble this will save. Paper can be marked off to any length cycle, the *Y* axis can be given a different cycle than the *X*, and interpolation is made possible.



Simple and logarithmic types of proportional interval divider

AUTOMATIC CONTROL FOR SEWAGE PUMPS

E. S. STATELER
Editorial Representative
Chemical Engineering
Chicago, Ill.

HOW TO COPE with "flash flood" conditions when operating at capacity was a serious problem at the plant of Corn Products Refining Co., at Kansas City, Mo., until about two years ago. Prior to that time the plant employed a 400 cu.ft. sump into which water from condensers, water-softener back-wash, and storm sewers drained, together with sewage from washrooms and toilets. Two constant-speed centrifugal pumps driven by 40-hp. motors were able to take care of ordinary conditions, but "flash" increases lasting about 5 min. would occur frequently due to back-washing, in addition to the sudden loads that might be added by rainstorms. Such surges caused operating difficulties and were often followed by the drawing of air into the pump intakes, which might take 15 min. to clear before the next surge could be handled.

Of the various possible solutions that were considered, the use of automatic control of the speed of the pumps was the best from several standpoints. Fig. 1 shows an outline of the automatic control hook-up that was worked out in conjunction with engineers of the Allis-Chalmers Mfg. Co. The pumps were provided with variable speed drives controlled by the liquid level in the sump. Each pump is controlled separately by the arrangement indicated in Fig. 1, although both might have been handled by the same control system except for the problem of synchronizing.

Standpipes on the sewage outlet lines (at 23 in Fig. 1) house the floats (15). Each float is connected by a chain (14) to pilot circuit contactor (11) which has the function of slowing down or speeding up the pump motor, depending on whether the water level is falling or rising. Part (11) is an ingenious electrical "follow-up" which through screw *C* causes moving part *B* to pull away from the float contact, moving part A, after a contact has been made, thus breaking the contact and stopping the pump speed-changing torque motor (3). In this way correspondence is obtained between water level and pump speed.

In more detail, if water level falls, a "slow-down" contact is made at (11) (see Fig. 2), energizing the slow-down time-delay relay (8) through flexible cable (10a) and three-position switch (10). This relay is connected through the limit switch (1) to the contactors (6) which control the motion and direction of rotation of torque motor (3). A lock-out relay (2), in series with (6), prevents operation of the speed changer if the pump motor is not operating. Assuming a drop in water level, then, slow-down contactor (6) closes and starts motor (3) in the speed-reducing direction. Through

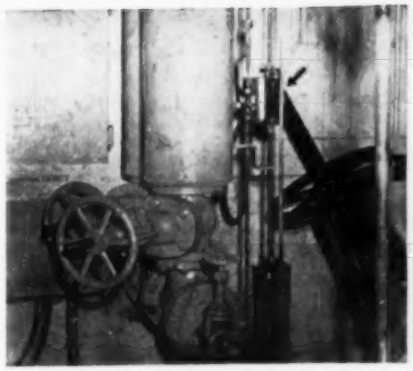


Fig. 2—Float switch with moving parts *A* and *B* and screw *C* (see Fig. 1)

sprockets (17) and (18) and chain (19) the speed changer countershaft (26) is turned, moving chains (27) and (28) to alter the variable transmission ratio and reduce the pump speed. At the same time through sprockets (20) and (21) and chain (22) limit switch (1) is moved toward the low limit of transmission adjustment; while sprockets (25) and chain (24) turn screw *C* so as to break the contact between *A* and *B* to stop the torque motor. Conversely, a rising water level completes the speed-increasing contact and turns the torque motor and speed changer oppositely.

Proper time delay features avoid hunting, yet give quick control. The float can operate through a range of about 26 in., with a definite pump speed for each water level. Both pumps can be operated together, or either one alone. Adjustments for variations in operating conditions can quickly be made by changing sprocket sizes. The new system operates effectively, rapidly following all flow changes, and has eliminated all earlier difficulties.

The writer wishes to acknowledge assistance of John Schipper and Lee Stalder of Corn Products Refining Co., and of A. A. Dahms of Allis-Chalmers Mfg. Co., in obtaining information used in this article.

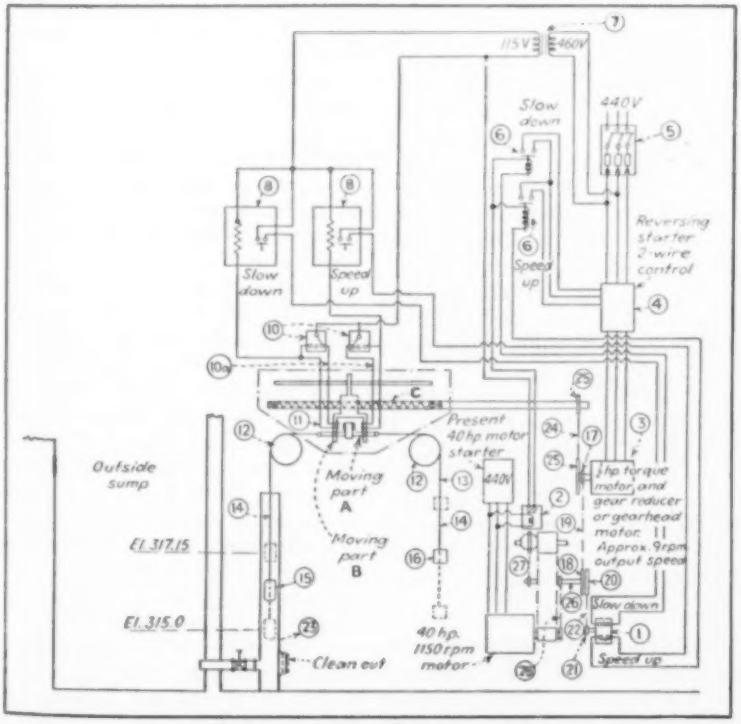


Fig. 1—Hook-up of principal equipment for controlling pump speed

PREVENTING EDGE LEAKS FROM FILTER CLOTH

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IN FILTERING many thin liquids in a filter press, filtrate is often lost by leakage from the edges of the cloths or papers. The loss is greatest when highly volatile solvents are used and flammable or toxic vapors may result from evaporation at the edges.

To overcome the leakage and evaporation of ethyl ether from a filter press used to clarify a solution containing a

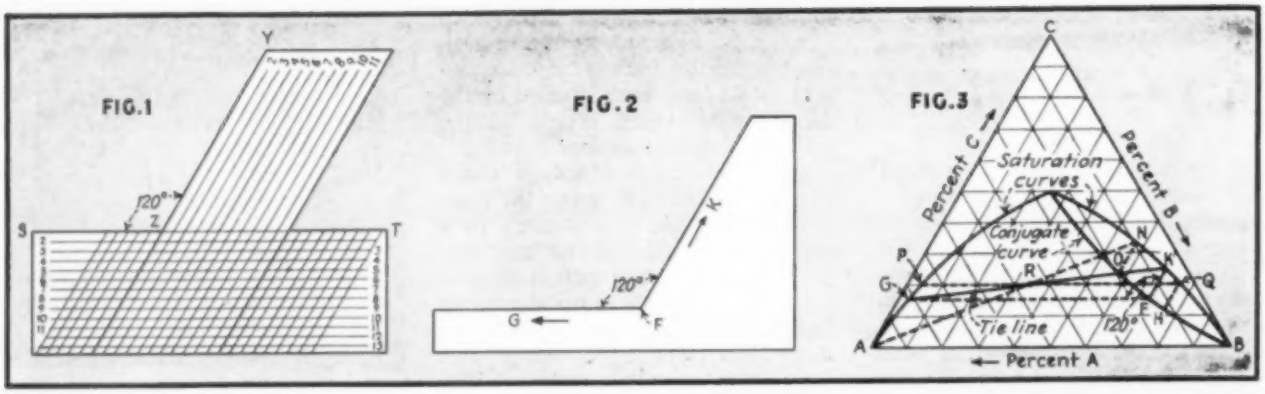

Fig. 1—Flexible 120-deg. triangle for locating tie lines

Fig. 2—Alternate type of 120-deg. guide for tie line location

Fig. 3—Typical three-component solubility diagram, showing tie line

large proportion of ether, we adopted a simple procedure. The sealing area of the filter pads was impregnated with a solution of nitrocellulose in acetone and allowed to dry.

The impregnation may be done rapidly by dipping the edge of the pad or cloth in the lacquer or by pouring lacquer around the outer edge.

On assembling the press it was found that even at pressures of 30 psi. no leakage was noticeable, the nitrocellulose sealing the pores of the filter and also assisting the gasket function of the cloth.

When the press was treated as above and used to filter nitrocellulose solvents, leakage at the edge was only noticeable after two hours filtering. Without impregnating the edge of the pad the press leaked as soon as filtration commenced.

LOCATING TIE LINES ON SOLUBILITY PLOTS

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IN WORKING with triangular three-component solubility diagrams, considerable time is frequently spent in locating the tie lines showing the equilibrium layers when only the composition of the over-all mixture is involved. When the tie line data are represented by a conjugate curve in the two-phase region, the usual method is to plot the tie lines by trial and error until the tie line through the mixture composition is located.

Although the method described here still involves trial and error, the time to locate the desired tie line can be lessened very materially by constructing an instrument from a transparent material such as plastic, which can be used as a flexible 120-deg. triangle. As suggested in Fig. 1 the device consists of two pieces of plastic, ruled with a series of numbered lines about ½ mm. apart. The sheet carrying the lines intersecting at 120 deg. is capable of sliding over the other sheet.

The theory of the method suggested is explained in Fig. 3 which shows the saturation lines (solubility curve) and the conjugate curve, as well as the composition of a mixture *R* for which the tie line is desired. A horizontal line *PQ* is drawn through *R* parallel to the base *AB*, and terminating at *P* and *Q* on the solubility curve. It is obvious that the composition of the upper level cannot fall below *Q*. Similarly, by drawing a line from *A* through *R* and projecting it to *N*, it is evident that the upper limit of the upper level composition is *N*. Hence, the upper level composition lies between *N* and *Q*. Furthermore, when *NO* and *QH* are drawn parallel to *AC*, it is to be noted that its intersection on the conjugate curve, as shown by *KF*, must lie between *O* and *H*.

So much for the theory. The instrument of Fig. 1 is simply a means of drawing a triangle *GFK* such that *R* lies on the line *GK* and *F* (at which point the angle is 120 deg.) lies on the conjugate curve. The instrument is placed on the diagram with *ST*, the top line of the horizontal portion, coincident with *PQ* on Fig. 3, and with *Z* on the sloping portion coincident with R. The numbered lines now intersect at 120 deg. and some of the intersections will fall on the conjugate curve, or close to it. Taking note of which lines thus intersect on or near the conjugate curve, one then uses a straightedge to connect the points at which the intersecting lines on the instrument cross the solubility curve (as at *G* and *K*). When the correct set of lines is found, the line shown by the straightedge will pass through *R*, and that line is the tie line.

(*Editor's Note*—A possibly simpler device suggested by Mr. Tabani's method is indicated in Fig. 2. A piece of plastic or cardboard is cut as shown, with a 120-deg. included angle at *F*. This device is laid on the diagram with point *F* on the conjugate curve and its bottom line parallel to the base line. The approximate location where the line *KG* will pass through *R* can be seen by inspection, while the exact location can be found almost immediately by means of a straightedge.)

GUNITE LINED TANKS SAVE ON THICKENER COST

OUTLINED in the September 1947 issue of *Engineering and Mining Journal* is a novel method recently used in the construction of four 100-ft. diameter thickeners which is estimated to have saved about half their total cost. These thickeners, installed at two clay plants of Edgar Brothers Co., McIntyre, Ga., employ conventional Hardinge "Auto-Raise" center-pier, center-drive thickener mechanisms, but the tanks are of earth, lined with Gunite concrete.

As described by C. D. Forbes, manager of the company, the tanks are built in ground which is substantially all clay, free from stones and boulders. The area for each tank was excavated by means of draglines, bulldozers and graders to a depth a few inches below the final operating bottom of the tank. A circular berm with its top at the original grade was thrown around the excavated basin and the earth surface on the bottom and sloping sides was then carefully shaped and packed. Sludge underflow pipes were laid below the tank bottom and the center pier consisting of steel-reinforced concrete was built. Steel wire mesh reinforcement was laid around the sloping sides and bottom and Gunite concrete averaging 2½ in. thick on the bottom and 2½ to 3½ in. thick on the sides was applied. The overflow launder was built by Guniting against a simple form set at ground level to form the inside and outside of the launder. A ¼ in. coating of Alumnite was applied for acid resistance.

THEN—Old distillery typifies the industry of a bygone era

NOW—Modern plant utilizes technologic advances

Recent Advances in FERMENTATION

Fermentation has long been important in the manufacture of beverages and solvents. However, within the last 25 years it has been used to produce organic acids and, more recently, fine medicinal chemicals. The growing importance of this unit process is a tribute to the relatively small number of chemical engineers who understand the principles of biology and bacteriology. This report outlines the biological principles of fermentation and describes advances.

UTILIZED by the ancients in converting sugar juices to alcohol, fermentation is perhaps the oldest known unit process. Certainly ethyl alcohol is one of the world's oldest and best known organic chemical compounds. Except for the manufacture of ethyl alcohol, fermentation as a unit process was of little industrial significance up to 35 years ago. Then, however, under pressure of the first world war, acetone-butanol fermentation was developed and put into commercial operation. This achievement was followed in the years after the war by increasing research which led to the industrial production of a variety of compounds such as organic acids. Even the ethyl alcohol industry progressed further in many respects after the repeal of prohibition in 1932 than it had for half a century before.

This progress set the stage for the remarkable achievement of the fermentation industries during the late war. Ethyl alcohol for synthetic rubber, of course, overshadowed the whole field in both volume and importance. Add to this the development of an entirely new branch of the fermentation industry, the production of antibiotics such as penicillin and later on streptomycin, and the importance of fermentation as a unit process takes on new significance.

Despite the growing importance of fermentation as a chemical engineering tool, relatively few chemical engineers (except those engaged in that branch of industry) have a realization of the problems involved in design and operation of fermentation processes. One reason for this is that fermentation is more than a chemical process. Rather it is a chemical change brought about by the metabolic process of microorganisms. Therefore, chemical engineers, if they are to deal effectively with this unit process, must have a working knowledge of biology and bacteriology.

Perhaps the one most important concept required by the designer of fermentation processes is that here one is dealing with living organisms rather than definable chemical compounds. The object of such a process is to control the activity of specific organisms so they will produce a maximum amount of a given substance in a form that can be recovered readily. In comparison to other chemical processes it isn't necessarily too difficult to control the ordinary process variables of temperature, pH, composition of raw materials, etc. But, even under opti-

mum conditions it is difficult to control the life cycle of a microorganism. To do this as completely as possible requires that the microorganism be shielded or isolated from all influences except the environment to which it is best suited.

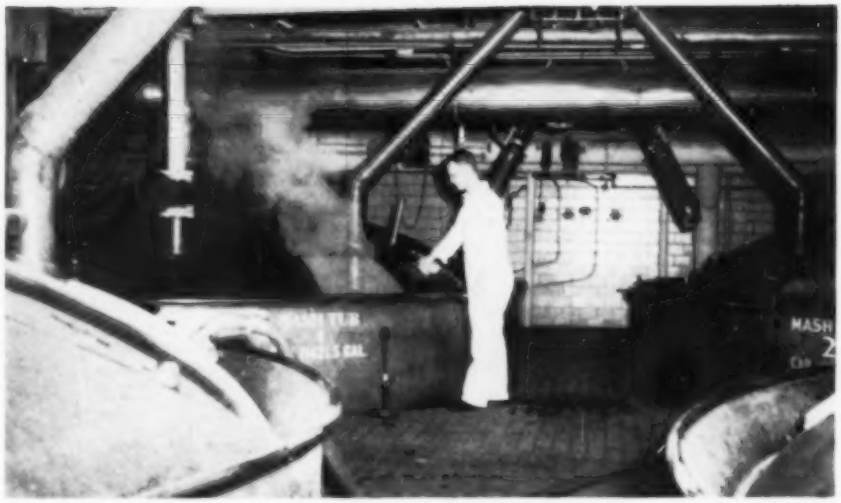
While all fermentations are not as critical as, for instance, butanol-acetone and penicillin, the trend in this field is toward the development of similar processes where pure culture conditions must be provided. As pointed out under the butanol-acetone process, entrance of any contaminants must be prevented for they may change the course of the process.

Process Design

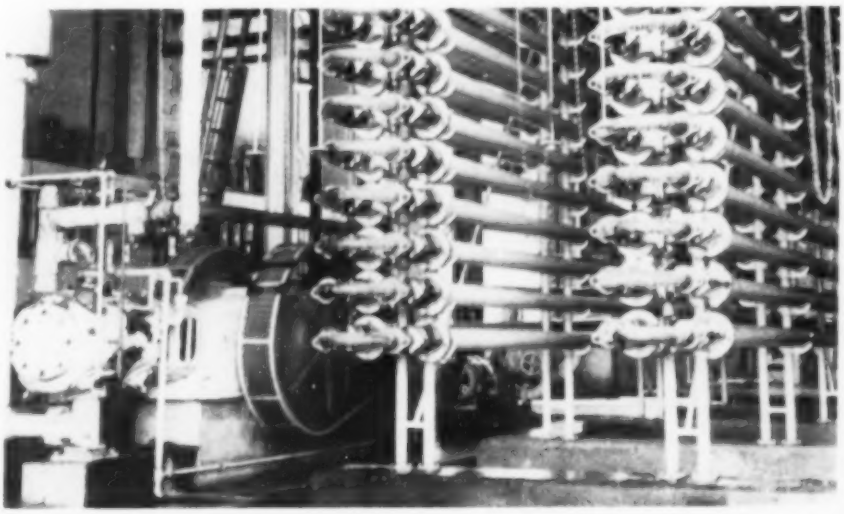
Equipment must be designed with smooth surfaces and with no cracks or crevices where organisms can lodge and begin their work. Piping systems must be designed with a minimum of valves and fittings since these are difficult to sterilize with even high pressure steam. Piping should be kept as simple as possible and should be laid out so that no air pockets will prevent sterilization temperatures from being reached. Large flanges with gaskets, and similar fittings are often sources of contamination since they are difficult to sterilize. This is especially true of heat exchangers and other equipment where the sterile material is separated from contaminants by pipe fittings.

With ordinary chemical processes these precautions are unnecessary since minute traces of foreign material, even in C.P. compounds, are tolerated. But when the contaminant is a living organism in a favorable growing medium, the situation is vastly different. For here, a single antagonistic microorganism can soon multiply sufficiently to substantially alter an otherwise well controlled fermentation. It has been estimated that 1 g. (wet weight) of a lactose fermenting organism breaks down from 200 to 15,000 g. of lactose per hr. Under favorable conditions up to 1,200 g. per hr. of urea may be decomposed by 1 g. of suitable microorganism. With this in mind, then, it is obvious that microbial contamination is completely different than ordinary chemical contamination, and because of this must be carefully guarded against.

Fermentation may be defined as a metabolic process wherein chemical changes are effected in an organic substrate through the action of biochemical catalysts (enzymes) secreted by living microorganisms. Specific chemical reactions depend on the type of organism, nature of the substrate

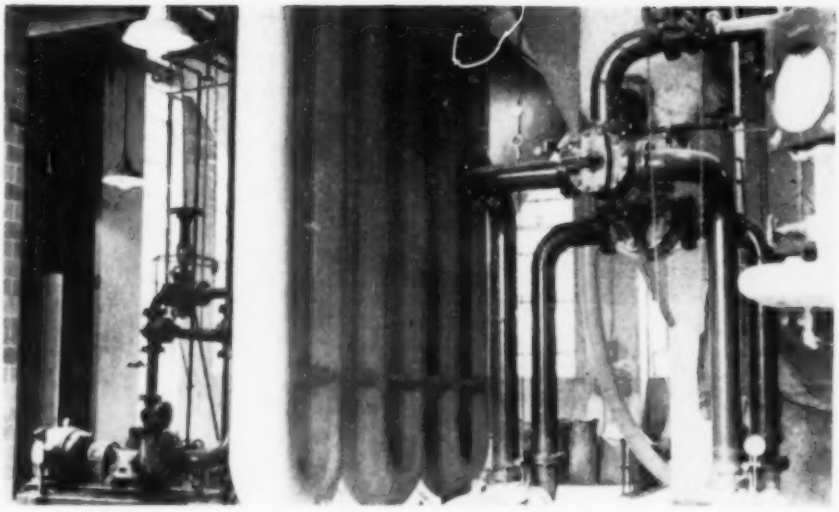


OLD—Open mash tubs are still widely used to cook grain meal for alcohol fermentation; each batch requires 2-4 hr.

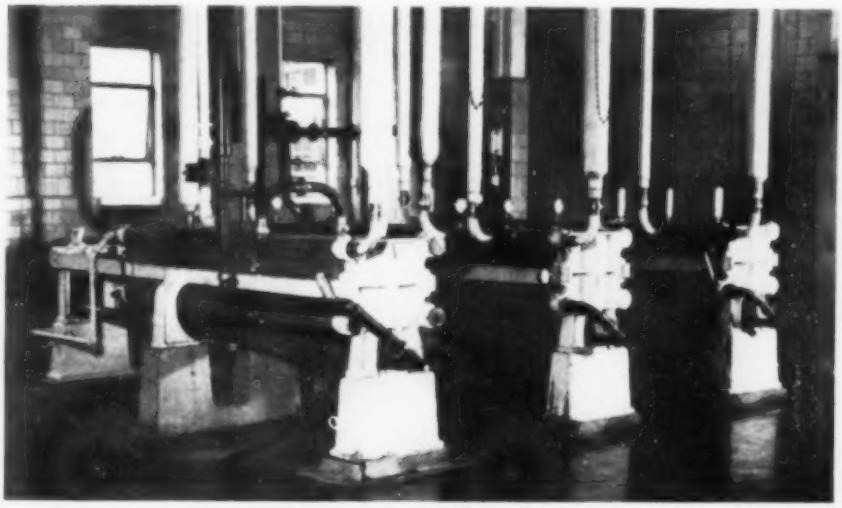


OLD—Hot mash from the atmospheric cooker is cooled from conversion temperature in water jacketed coils before going to the fermenters

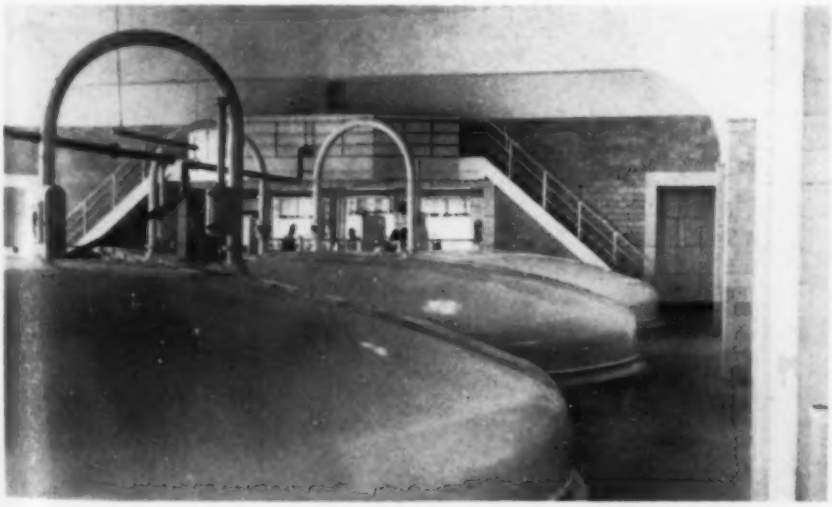
OLD—Open wooden fermenters present problems in sanitation and are subject to contamination; CO_2 is lost to atmosphere



NEW—Continuous cooker operates at high temperature with low reaction time; requires less space and equipment than batch method



NEW—Plate type heat exchangers are increasingly used to cool mash before fermentation; this cooler is more efficient and easier to clean than jacketed coils



NEW—Modern closed fermenters make possible recovery of CO_2, are easy to sterilize and permit better control of fermentation process

(medium in which organism is grown) and other process factors.

Microorganisms require specific environmental conditions to produce desired effects. Such factors as nutrient concentration, temperature, degree of acidity or alkalinity (pH), as well as available oxygen supply must be carefully regulated for each fermentation. With regard to oxygen supply some microorganisms require air (aerobic) and others (anaerobic) complete their life cycles without air. In reality, a number of chemical unit processes are brought about by fermentation such as oxidation of alcohol to acetic acid, reduction of acetaldehyde to alcohol, and hydrolysis of starch to glucose. On the other hand, many of the chemical changes caused by microorganisms or their enzymes are too complex to be readily classified since the exact mechanisms involved have not in many cases been firmly established. Included here is the formation of alcohol from glucose, as well as the acetone-butanol fermentation.

Industrial Microorganisms

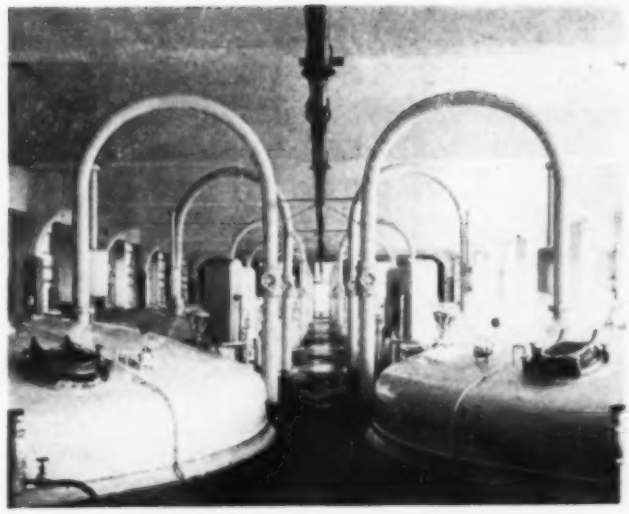
Although the number of different microorganisms is extremely large, those that can be utilized industrially are relatively few. The industrially important microorganisms may be characterized as having three outstanding qualities, namely: the ability to propagate rapidly in suitable organic substances and to be easily cultivated in large quantity; the ability to maintain physiological uniformity and to produce enzymes at a high rate; and the ability to carry out these transformations under comparatively simple and easily obtainable environmental conditions without the application of large quantities of energy. Practically all microorganisms can grow rapidly in the proper medium and under favorable environmental conditions. But only a few of them yield significant quantities of useful and valuable products.

The role of enzymes in fermentation is fundamental. Enzymes are universally associated with living matter and are the essential organic catalysts possessed or produced by all living cells without which life processes would be impossible. Fermentation microorganisms possess a marked ability to produce enzymes and the specific enzymes of individual types of microorganisms cause the chemical changes that take place in particular fermentations.

Organic substances or substrates, in which the microorganisms grow, provide nutrition for growth and act as

Three Types of Microorganisms

Practically all microorganisms can grow rapidly in the proper medium and under favorable environmental conditions. But only a few of them yield significant quantities of useful and valuable products. Fermentation industry utilizes various species and strains of yeasts, bacteria and molds. The following illustrations represent equipment for fermentations using these three types of microorganisms.



YEASTS are unicellular plants used principally to produce alcohol from sugar solutions; ethyl alcohol fermenters

raw material to be transformed to useful products. Breakdown of nutrients in fermentation results in evolution of energy in the form of heat, the quantity of which depends on the specific fermentation. In the early stages this is always accompanied by formation of new cells. Differentiation must be made between growth of the microorganisms and conversion of the substrate to a useful product. For instance, in manufacture of yeast, conditions are maintained for maximum growth of new yeast cells while in producing alcohol from sugar the environmental conditions are such that fewer yeast cells are produced but a larger amount of the substrate is converted to final product. In most industrial fermentations the original culture of a microorganism is grown under optimum conditions in seed tanks to obtain large numbers of cells before the main body of nutrient is inoculated. Then conditions are modified to suppress the forming of new cells and to promote enzyme secretion for the purpose of decomposing the medium. Thus process conditions can be controlled to encourage multiplication of the organism or to provide maximum enzyme activity in formation of the desired product.

Industrial Fermentation

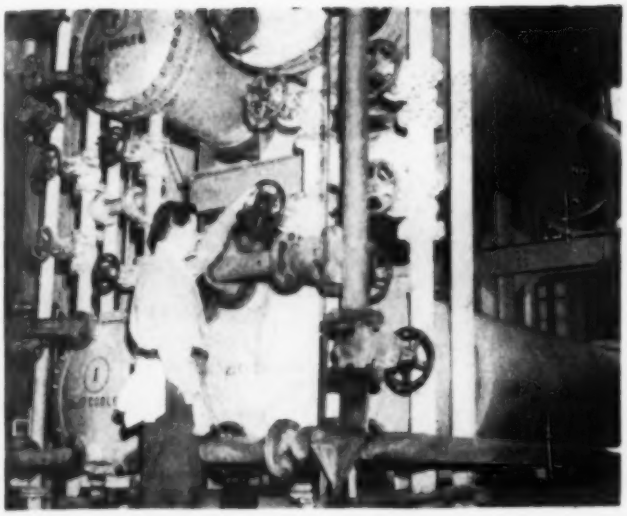
It becomes clear, then, that a successful industrial fermentation process is much more than merely inoculating an organic medium with living organisms. Rather it requires the setting up of a system of biochemical reactions between a substrate and an organism so that a controlled decomposition of the substrate takes place. The substrate must be readily available at low cost and the organisms must have the ability to attack, by means of its enzymes, compounds of the substrate and by hydrolysis, oxidation, reduction, or other processes (or combinations of processes) modify the molecules to form useful end products.

While a large number of products can be made by fermentation, there are relatively few fermentation processes carried out on an industrial scale. Use of this unit process is limited in many cases by inherent difficulties in handling a particular microorganism, such as unavailability of suitable low cost raw materials, low yields, a sluggish fermentation and difficulty of product recovery and purification. As in every other process the economic balance bulks high in determining the feasibility of a process. Thus, chemical synthesis often vies with fermentation on the basis of both quality of product and cost of production. On the other hand, the economic success of many ferementation reactions in manufacture of certain compounds is well recognized. In such instances, the selected organisms give a high and consistent yield of the desired product in a sufficiently short period of time from a low cost, readily available substrate. Most important, of course, is the uniqueness of the product and the difficulty of its manufacture by other methods. Thus, certain fermentation processes such as industrial alcohol may face increasing competition from the synthetic product both from ethylene and, in the future perhaps, from the Fischer-Tropsch synthesis. Conversely, in the case of penicillin, concentrated research effort so far has not yielded a synthesis process. Here, the product is unique and extremely valuable and it has no direct competition. It is now recognized that it may be more practical to utilize microbiological processes to decompose partially a complex compound to a desired end product than it would be to build up the product from simple compounds by synthesis. In light of these facts it appears that the future for fermentation lies in biological synthesis of complex molecules rather than of more simple molecules.

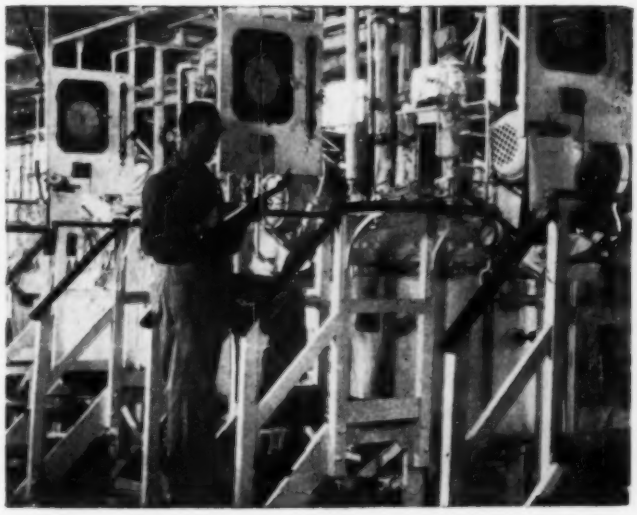
Yeasts, Molds, Bacteria

Three groups of organisms find application in the fermentation industry, namely, yeasts, bacteria and molds. Yeast are utilized in production of alcohol beverages, yeast concentrates, and may be used to make glycerol. Bacteria are used in manufacturing various products including butyl alcohol (butanol), acetone, butylene glycol, acetic acid and lactic acid. Molds are employed in producing citric acid, gluconic acid, mold enzyme preparations, and antibiotics such as penicillin and streptomycin.

Yeasts are unicellular plants that are widely distributed in nature, occurring in top layer of soil and on the fruits and leaves of many plants. They grow best in media containing an abundance of sugar and other nutrient substances including mineral salts containing phosphorus, magnesium, sulphur, calcium and chlorine. Bacteria are also unicellular and occur in nature in a great variety of types. Industrially important bacteria fall in two classes based on their relationship to atmospheric oxygen, namely, anaerobic and aerobic. Molds differ from yeasts and bacteria in that they are multicellular. They are esentially aerobic in nature and cause a wide variety



BACTERIA may be aerobic or anaerobic; sterile mash cooler for butanol-acetone fermentation



MOLDS are multicellular plants (aerobic) used for organic acids and antibiotics; pilot plant fermenters for streptomycin

of reactions including the production of antibiotics.

Although fermentation processes differ in many respects in general they follow a similar pattern as follows: (1) preparation and propagation of pure microorganism culture, (2) preparation of the substrate or nutrient medium which is acted upon by the microorganism, (3) controlled fermentation, (4) separation and recovery of the products and byproducts from waste materials. Several of the more important industrial fermentation processes will be discussed, not for the purpose of giving detail, but to indicate the advances in technology.

Ethyl Alcohol

Industrial alcohol is by far the largest tonnage fermentation product. Add to this the many other products of alcoholic fermentation such as beer, wine and distilled liquors and it is the most important single type of fermentation. However, many of the technological advances in recent years have come in connection with industrial alcohol because of the tremendous wartime requirements and the expansion of the industry to meet these needs.

Prior to the war from 70-75 percent of industrial alcohol was produced by fermenting molasses, about 20 percent was synthesized from ethylene and the remainder from grains and other materials. Early in the war, however, the molasses supply was largely cut off and it became necessary to utilize grain such as wheat, which previously had not been used for this purpose. Other materials employed to produce alcohol are potatoes, fruit wastes, waste sulphite liquor and wood waste. In 1945, the all-time peak year, approximately 73 percent of the total production of more than 550,000,000 gal. was derived from grain, about 17 percent from molasses and about 10 percent from ethylene. Other sources contributed less than ½ percent.

In 1946, the following year, total production dropped back to less than half the 1945 figure, most of the cutback being in alcohol from grain. In that year about 2 percent or 6,000,000 gal. was produced from sulphite liquor and wood waste.

Now, as before the war, alcohol economics tends to control the selection of raw materials and processes used in production. Closing the wood saccharification and fermentation plant at Springfield, Ore., points up the fact that economics is beginning to hold sway again. Perhaps it will be a different story with the Bellingham, Wash., sulphite liquor plant, for here alcohol production aids in solving a difficult waste disposal problem. Undoubtedly, fermentation alcohol in general will improve its position when and if agricultural products and byproducts (grain and molasses) come down in price. But the constant threat of more synthetic alcohol both from ethylene and from the Fischer-Tropsch process is somewhat of an economic club over the fermentation processes.

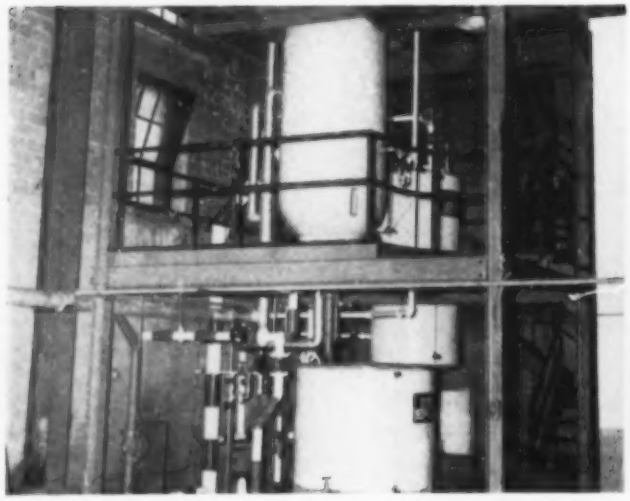
Technologic Advances

Major technological developments in alcohol fermentation may be summarized briefly. Molasses fermentation was fairly well established before the war and didn't change appreciably. Grain processing, however, which had been operated on a strictly batch basis made real strides in going to continuous cooking and hydrolyzing processes. It is estimated that approximately 35 percent of alcohol production during the war utilized continuous cooking processes. Some progress was made toward continuous fermentation but, except for the sulphite liquor plant at Bellingham, Wash., continuous fermentation is not used on a commercial scale. During the war, wheat was used for the first time for large scale production and while this was successfully accomplished after a short period of experimentation, use of wheat was discontinued in 1946. With the present outlook for the world food supply, wheat isn't likely to be used for such purposes in the foreseeable future. Development of mold bran, produced by growing molds on wheat bran, as a substitute for barley malt in conversion of starch to sugar was brought to commercial fruition. Considerable research is still being devoted to development of mold enzymes for this purpose. Large scale production of alcohol from both sulphite liquor and wood has been carried out successfully and, while these processes in themselves may not represent a large volume of alcohol production, they do mark real progress in utilizing waste materials.

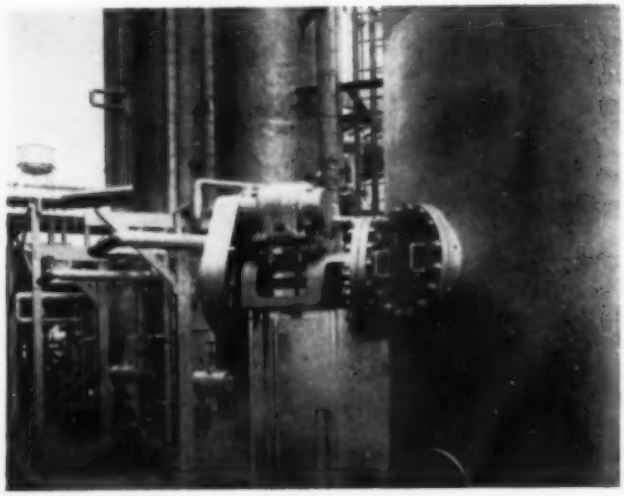
Continuous Processes

Probably the most important of the above mentioned processes is the development of continuous cooking and mashing of grain. The first step in making alcohol from grain is conversion of the starch into fermentable sugars. The starch cells are first solubilized by cooking and then converted to sugar with malt. The common system is to employ large vats

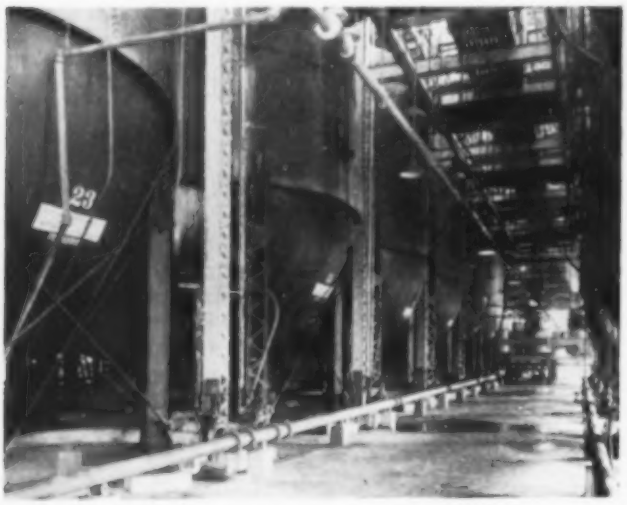
Four Steps in Fermentation



1 Prepare pure culture of microorganism (yeasts, bacteria, molds); this is a continuous yeast-making system



2 Prepare substrate or nutrient medium; here, corn steep liquor is prepared for penicillin production



3 Ferment nutrient medium by innoculating with pure culture; battery of 50,000 gal. butanol fermenters

4 Recover products from fermentated liquor; filtration to remove mycellia from penicillin solutions is shown here

where the grain meal is mixed with water, heated with direct steam and agitated. Malt is added at a lower temperature. When conversion is complete the mash is cooled and then sent to the fermenter. This process requires from 2 to 4 hr. per batch.

An improvement on this is the use of pressure vessels instead of open vats. Here the grain is mashed at about 65 lb. per sq. in. pressure, with direct steam.

Continuous Cookers

Two types of continuous cookers were developed and put into commercial practice. One process operates at high temperature with a short holding time while the other operates with a lower temperature and a longer retention time.

The first process utilizes a pipeline cooker. Grain, water and stillage are slurried together and are pumped through a special heating jet where it is mixed with steam at 350-360 deg. F. The hot slurry passes to the pipeline cooker designed to give a 1-2 min. holding time. Cooked slurry is flashed to a vacuum cooler and is then mixed with the malt slurry where conversion takes place almost instantly and the hydrolyzed mash is discharged to the cooler. The total retention time of the system is approximately 6 min. Some of the advantages of the system are that approximately 80 percent less equipment is required; low pressure steam can be recovered and used in other parts of the plant; the process can be more easily controlled to obtain a better, more uniform product; less labor is required; and operating costs are lower. A similar cooker can be used for acid hydrolysis. Here the dilute acid is added to the slurry which is later neutralized with $CaCO_3$ prior to being discharged to the cooler.

A continuous cooker embodying low temperature and long holding time consists of a vertical tower. Heated slurry of grain and malt is pumped in at the top and completely hydrolyzed mash is continuously withdrawn from the bottom. This system has the advantage of being able to utilize low pressure steam and can be installed where existing boilers operate at low pressure.

Considerable work has also been carried out in developing a continuous fermentation process. Such a process has been operated successfully on a small scale but as yet hasn't been put in commercial production. Here, a sterile mash is continuously added to a fermenter which has a capacity sufficient to allow a retention time of about 8 hr. Fermented mash is withdrawn continuously to a beer well having a capacity to permit a 2 hr. retention period. From here the mash is fed directly to the distillation process.

Yeast Propagation

In a similar manner, a continuous process has been developed and tested on a pilot plant scale for developing yeast cultures. This process, while not necessary for the continuous fermentation system, should be applicable to batch fermentation as well as to commercial yeast manufacture. In ordinary practice, yeast for inoculating the fermenter must be propagated in several batch steps to provide a sufficient concentration of pure yeast cells so that rapid fermentation will take place. The yeast is prepared under aseptic conditions (absence of all other microorganisms) by first growing a pure culture of the desired yeast strain in a test tube of sterile wort broth. This culture is used to inoculate a larger tube or flask of sterile mash and, after incubation, a still larger flask is seeded. This "build-up" procedure is continued two or three times more until a "starter" of several thousand gallons is obtained which is used to inoculate the large fermenters. Aeration improves the growth of yeast.

Although different yeast propagating systems have been used in the past, a continuous process seems quite promising. This consists of growing the yeast in specially designed equipment on a sterile broth which is aerated with sterile air. After about 4 hr. of active growth the yeast wort is removed continuously at the bottom and pumped to a centrifuge where the yeast cell concentration is increased from about 500,000,000 to 2,000,000,000 per cc. The supernatant fluid containing some alcohol is sent to the distillery and the yeast transferred to refrigerated storage where it is kept until needed. Sterile wort is continuously added to the fermenting vessel and finished yeast continuously withdrawn. The complete cycle has been reduced from the 36 hr. required by the fastest of other processes to about 5 hr.

Pure culture techniques must be employed otherwise foreign microorganisms will be propagated along with the yeast. While ordinary alcohol fermentation is not carried out under aseptic conditions, it is necessary to innoculate with pure yeast cultures to obtain maximum yield. Even so, it is necessary to shut down and clean fermenter equipment periodically to prevent loss of production due to "wild" strains of yeast and other organisms.

One disadvantage of the continuous fermentation process is that foreign microorganisms tend to build up concentrations to the point where yields are lessened. In addition, since no new yeast is added after starting the continuous process, the new yeast cells formed tend to evolve different characteristics than those possessed by the original culture. Mutation, as this is called, is one of the serious problems in all fermentation processes. While a continuous system would be small and compact for a given capacity, many mechanical complications are introduced by the necessity for maintaining the system free of infection.

Mold Enzymes

Shortage of barley malt led to the development of mold enzymes for use in hydrolyzing grain starches to sugar. One type of mold enzyme is made by growing the mold *Aspergillus oryzae* on a sterilized, acidified mixture of wheat bran in small rotary drums or in aluminum pots equipped for aeration. After incubating at 35 to 45 deg. C. for a period of 20-40 hr., the moldy bran is dried in air at room temperature and is ground to a coarse powder and may then be used to hydrolyze cooked grain mashes in a manner similar to malt.

Utilization of mold as a malt adjunct is thought to be quite promising and considerable research has been devoted to this work. Prior to the war there was little desire to use anything but malt since this might change the flavor of fermented grain liquors, but the use of grain to make industrial alcohol during the war stimulated this work on amylolytic molds. Some work has been done on growing these molds on stillage so that industrial alcohol can be produced with a hydrolyzing agent manufactured on the premises.

Sulphite Liquor

Alcohol from sulphite liquor was produced in two plants during the war, one in Thorold, Ont., and another, as previously mentioned, in Bellingham, Wash. The former plant started operating in 1943 and the latter not until 1946. The Bellingham plant is somewhat similar to the Thorold unit but has a capacity of about 5,500 gal. of 190 proof alcohol per day. Sulphite liquor is first aerated to free it of SO_2, cooled by flashing the hot liquor in a vacuum cooler, and limed to adjust the pH. Vacuum cooling partially concentrates the liquor which contains only about 2 percent sugar. The fermentation is carried out continuously in wooden fermenters equipped with agitators to keep the yeast in suspension which aids the fermentation in going to completion. The fermenting mass flows through a battery of fermenters by a simple system of overflow lines and is discharged from the last fermenter to a beer well from which it is distributed to centrifugal separation. Separated yeast, about 1/10 the volume of the fermented mash, is returned to the first fermenter in the series where it inoculates the feed.

Organism Acclimatization

Sulphite liquor fermentation is an example of the acclimatization of an organism to an unfavorable environment. When the liquor is first inoculated, results are indifferent but by continuous yeast separation and reuse, a body of yeast is built up which functions satisfactorily. Acclimatization of yeast to the liquor increases the yield about 25 percent. One reason for the need to acclimate the yeast to the mash is that the liquor contains toxic substances such as methanol, furfural and SO_2. If the mash were not toxic, however, foreign organisms would more easily establish themselves to constitute a serious infection hazard. Therefore, continuous operation of the fermenters is successful without taking the elaborate precaution of operating a pure culture fermentation.

Unfavorable characteristics of this type of sulphite liquor utilization are the low sugar content which when converted to alcohol requires a distillation steam load some four times greater than that used in the distillation of molasses or grain mash. Since the fermented mash is corrosive, much of the equipment must be acid resistant. Technologically, the sulphite process is successful but its widespread use will be limited by inescapable economic factors. With high molasses and grain prices, this process may well be economical. If byproducts such as lignin ever find extensive use, the economic picture will improve.

Butanol-Acetone Fermentation

Second only to ethyl alcohol in volume, the butanol-acetone fermentation is a major source of industrial solvents. Developed during the first

world war to produce acetone for explosives manufacture, it later became more important in turning out butanol for use as a solvent in nitrocellulose lacquers. While large quantities of both acetone and butanol are now manufactured by synthesis methods, fermentation still is responsible for the bulk of the butanol although far behind the production of synthetic acetone.

For many years grain was the only raw material used in this process but the low cost of byproduct molasses led to the finding of bacteria strains that would ferment sugar solutions satisfactorily. Various species and strains of *Clostridium acetobutylicum* can produce ratios of butanol ranging from 55 to 74 percent, acetone in proportions from 5 to over 40 percent, and ethyl alcohol as low as 2 percent by weight of total solvents. The organism used in a particular process should be selected on the basis of the nature of the raw material and ratio of end products desired.

Pure Culture Fermentation

This fermentation is subject to some critical process factors that are worth discussing. Since butanol-acetone can only be produced by a pure culture fermentation it is necessary to maintain sterility of all process equipment and materials entering the process to reduce the possibility of contamination to a minimum. Various precautions are taken such as sterilization with live steam, use of antiseptics where possible, and steam sealing openings into the fermentation equipment. Prevention of contamination at time of primary inoculation is of fundamental importance since acid-forming organisms introduced here will multiply during seed stages and may build up sufficiently to lower the yield or even stop the fermentation. Since pH of the fermentation is around 6, the medium is favorable to acid forming organisms in general. These organisms, introduced into the system, can overgrow the solvent producing bacteria, since the invaders are more tolerant of acid than the solvent producers. This changes the whole course of the fermentation with possible loss of the complete batch. This is in contrast to ethyl alcohol which gives low yields under unfavorable conditions but seldom fails completely as is the case with the butanol fermentation.

One of the serious difficulties in fermentation of butanol is its susceptibility to bacteriophage. The process starts with the organisms multiplying in the mash and building up acid in characteristic fashion. Normally these acids disappear with the forming of solvents and the process is ended with low acid and low sugar content. When the fermentation is sluggish, the acidity peak is reached but the organisms fail to continue the process of forming solvents and the fermentation ends with high residual sugar. This phenomena is extremely serious and has occurred in both new plants and old ones. Bacteriophage has been known to cause plants to shut down because of low yields.

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Butylene Glycol

No discussion of wartime research in fermentation is complete without including the work of developing a successful process for making 2,3-butylene glycol. Interest in this compound stemmed from the fact that it can serve as a precursor of butadiene used to make synthetic rubber. A large scale pilot plant was built to make butylene glycol and convert it to butadiene and it operated successfully for a short period. Although the butylene glycol process did not contribute directly to the synthetic rubber program, its development was a forward step in fermentation technology. Briefly, the process is as follows. Grain meal mash is cooked and the starch hydrolyzed to sugar. After sterilization the mash is fermented using a pure bacteria culture to form butylene glycol. Fermented mash is allowed to settle; clear supernatant liquid is removed, concentrated in an evaporator and the butylene glycol recovered by countercurrent extraction with butanol. It is separated from the solvent by distillation after which it is converted to butadiene by first esterifying to the diacetate, then cracking at about 1,100 deg. F. to butadiene. Butylene glycol has a number of possible applications including use in resins and as a solvent.

Organic Acids

Although the organic acids made by fermentation such as lactic, citric, and gluconic acids have been well established industries for some time, considerable research has gone into improving processes. However, since their manufacture is confined to only a few companies, actual process improvements are not readily ascertained. One process that has received considerable attention is the fermentation production of citric acid. This is an aerobic mold fermentation carried out commercially in shallow trays. The development of deep or submerged aerated fermentations of antibiotics led to considerable research toward the development of a similar process for citric acid. Undoubtedly, this work will lead to a better, more efficient process to take the place of the surface fermentation process.

Up to about 10 years ago, gluconic acid was made by fermentation in shallow pans contained in special cabinets to prevent contamination. At that time, a rotary type fermenter was designed and put into successful operation to increase yields up to 40 percent and to cut fermentation time by several days. The fermenter is a horizontal cylindrical aluminum drum containing flights or baffles. It is operated under about 30 lb. per sq. in. pressure of sterile air. Critical factors are speed of rotation, air pressure and flow, temperature and pH.

Antibiotics

Undoubtedly the development of methods to produce antibiotics is among the remarkable scientific and engineering achievements of the war period. The processes for making both penicillin and streptomycin have been well publicized and need not be described. Development of submerged fermentation processes to replace surface fermentation was one of the biggest factors in developing large scale production. The sensitivity of these products in fermentation, recovery and purification made the whole process doubly difficult. Throughout the whole process, new techniques had to be devised to cope with difficulties for which no precedents had ever been set.

Acknowledgments

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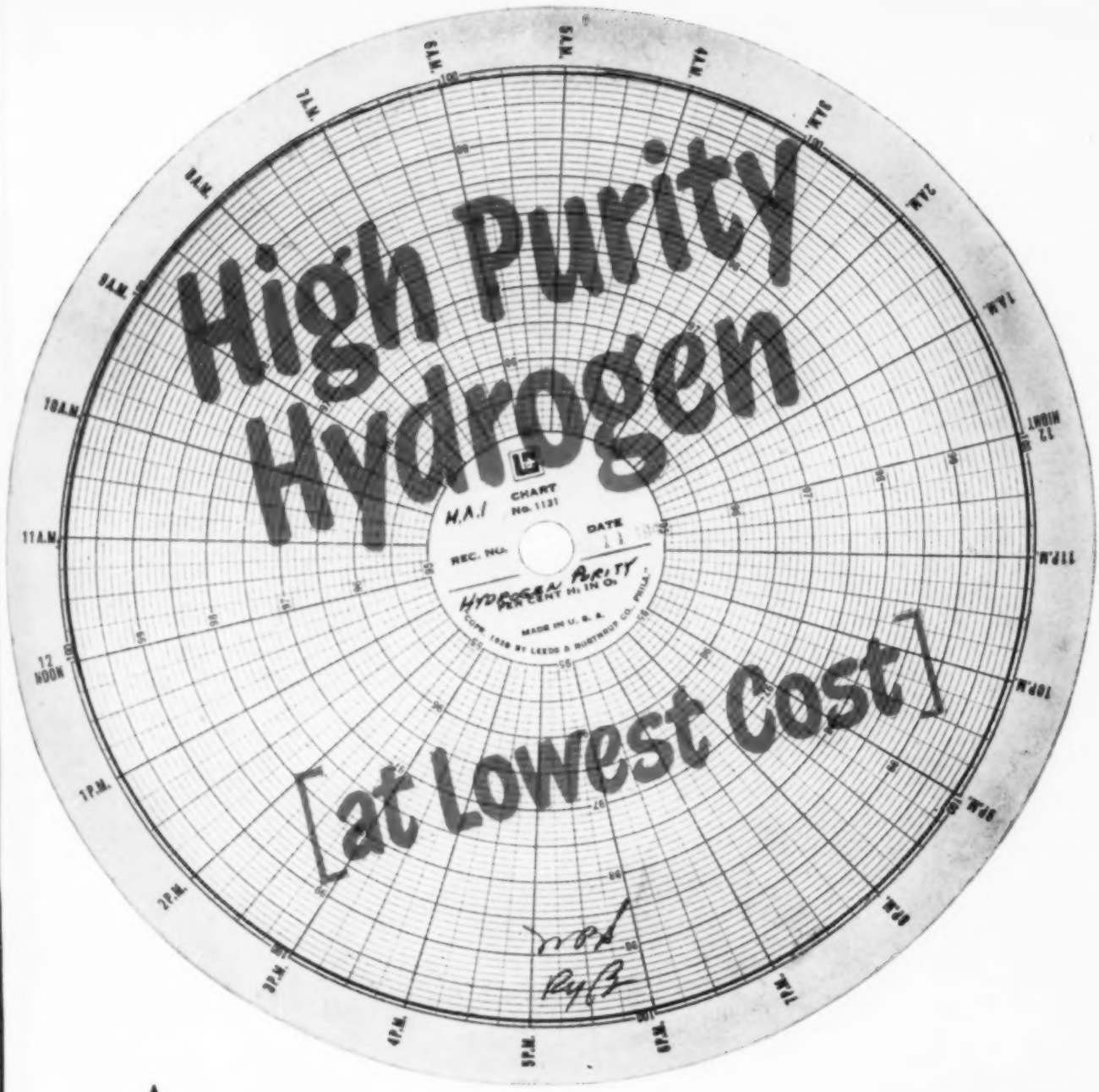
Photographs were supplied by Joseph E. Seagram & Sons, Inc.; U. S. Industrial Chemicals, Inc.; Commercial Solvents Corp.; Merck & Co., Inc.



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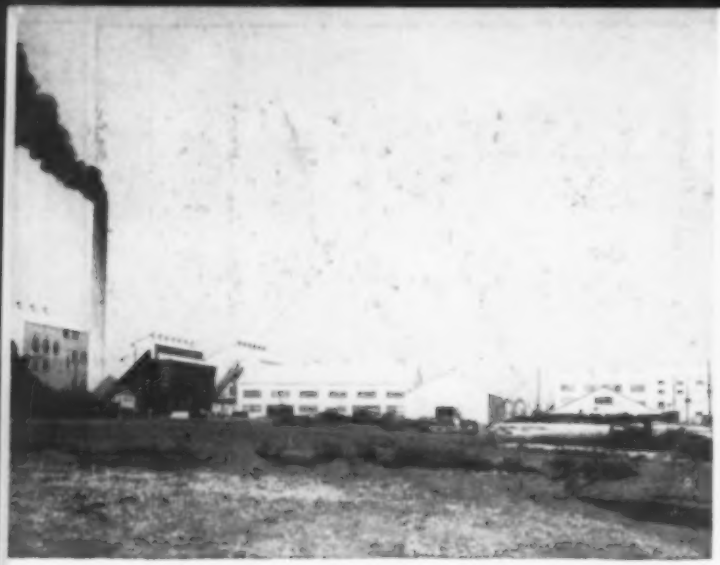

Crosby plant at De Ridder, La., chews up pine stumps hungrily to make wood rosin and terpene specialties

1 Trucks haul yellow pine stumps to plant from as far as 65 mi. away. Average haul is 35 mi. Plant uses 750 tons daily

Rosin and Terpene Oils

YELLOW PINE stumps hauled by truck to the naval stores plant of Crosby Chemicals, Inc., near De Ridder, La., are washed, ground, shredded and screened before being conveyed to storage and thence to the extractor house. There they are dumped into steel extractors. Ten of the 16 extractors, each of which holds 15 tons of chips, are operated simultaneously in series in the extraction phase. Extraction with naphtha takes place at 265-280 deg. F. and 65-85 psi. ga. Spent chips are used as fuel. Leaving the extractors, crude solution of rosin and terpene oils goes to the FF refinery and still house. Solvent is recovered in two vertical-tube, atmospheric-pressure evaporators connected in parallel. Remaining naphtha is removed in a flash tower kept under a vacuum of 15 in. Hg by steam jet ejectors. Rosin and terpene oil mixture is pumped to two finishing towers where steam strips terpene oils from rosin. Towers are under a vacuum of 27 in. Hg. Water is separated from terpene oils and they are washed with 20 percent caustic. Oils are then fractionated in batch stills, yielding turpentine, pine oil and other components. Primary distillates are re-fractionated in the same stills into terpene specialties. Pine oil foots from still bottoms go to other processors. Still molten FF rosin is diluted with naphtha to 50 percent solution in four mixing tanks, pumped into six wash tanks, further diluted to 15 percent rosin content, and sprayed with water to wash down color bodies. Nigre, a heavy, dark resin, is withdrawn periodically from bottoms of wash tanks. Rosin-naphtha solution is next pumped into the pale plant where final color reduction is accomplished by adsorption on magnesium trisilicate packed in adsorption towers.

Pale rosin solution goes into two vertical-tube evaporators connected in series for naphtha recovery. The first evaporator operates at atmospheric pressure; the second, under a vacuum of 15 in. Hg. A final fractionator recovers terpene oil traces from the rosin. In the rosin shed most rosin is drummed for shipment. Some is cooked with 25 percent aqueous soda ash in a steam-coil-heated vat to make paper size. Some is made into limed rosin by stirring 3 to 4 percent of calcium hydroxide into it. Byproduct of pale rosin manufacture is Berez. For details see pp. 119-121.

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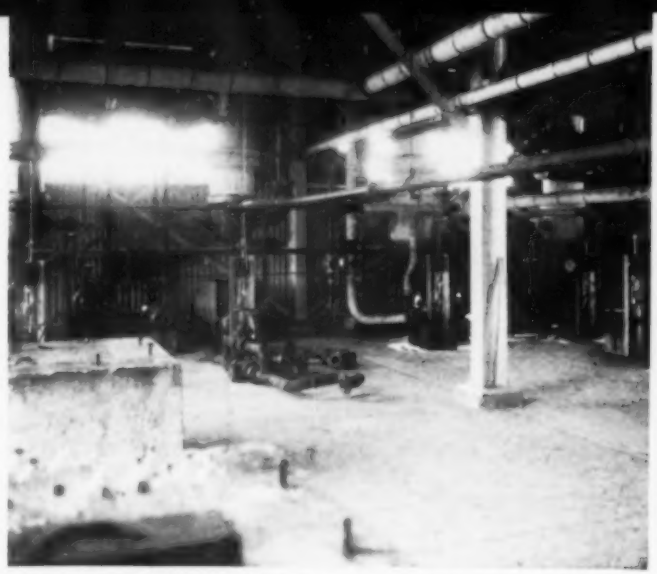
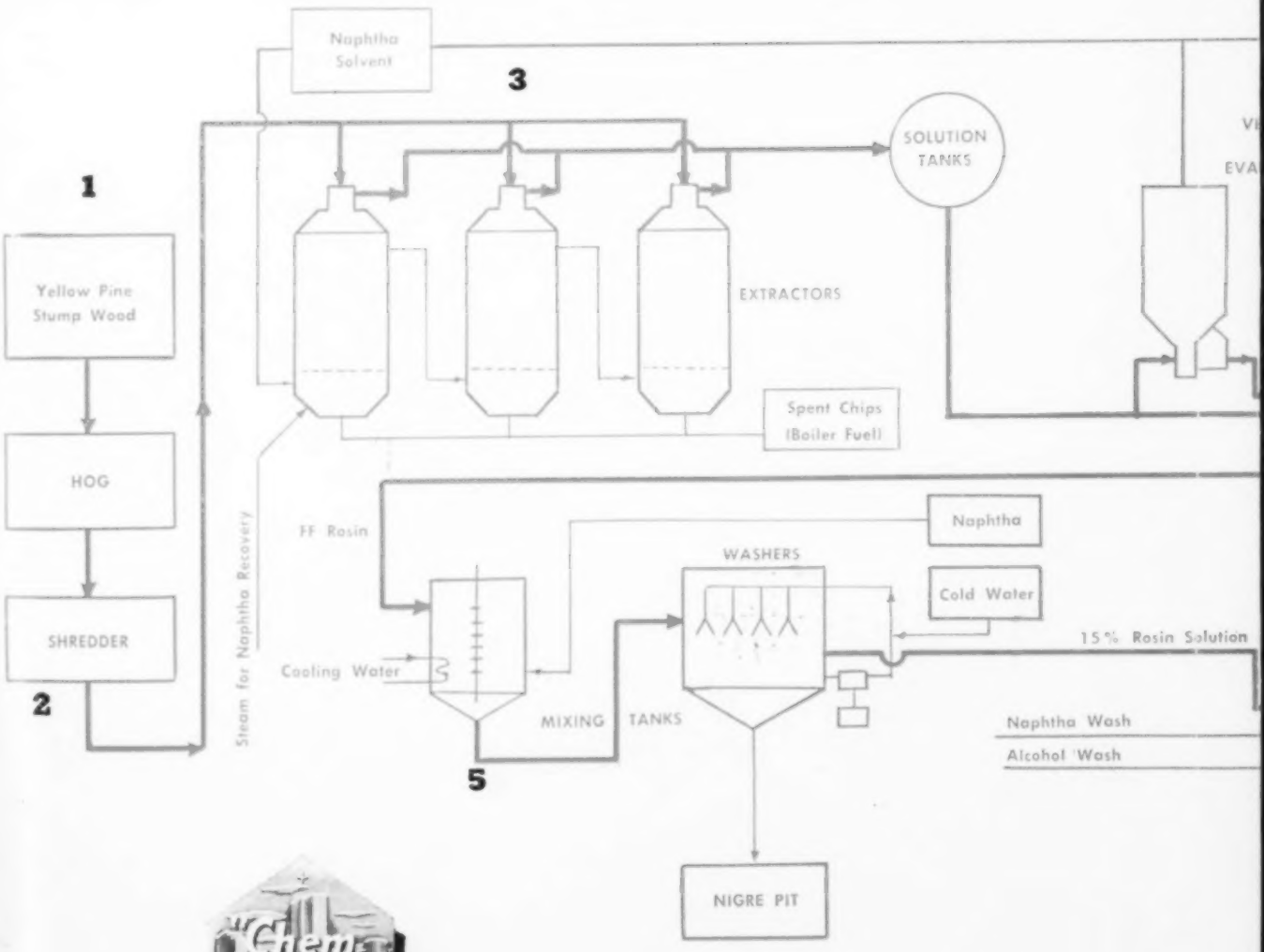
2 Conveyors carry stumps from yard to hogs and shredders in mill room

3 Pine chips from mill room are dumped into these extractors. Solvent naphtha extracts rosin and terpenes. Spent chips come out through rectangular doors

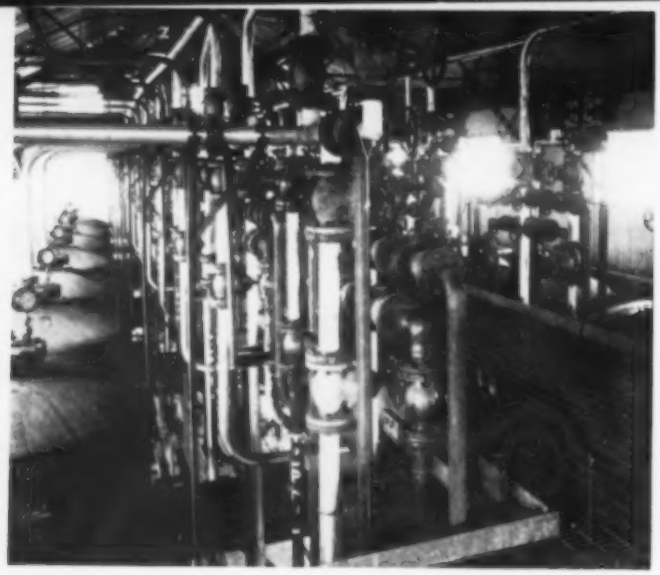


4 In this FF refinery bulk of solvent naphtha is recovered from rosin and terpene oils. Rosin and oils are then fractionated

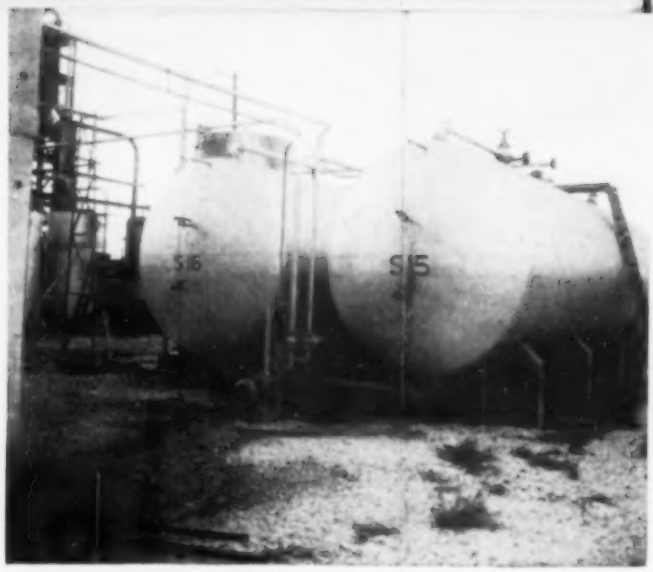
5 Mixed with naphtha in four front tanks, FF rosin next enters six wash tanks in rear row where water spray washes down nigre



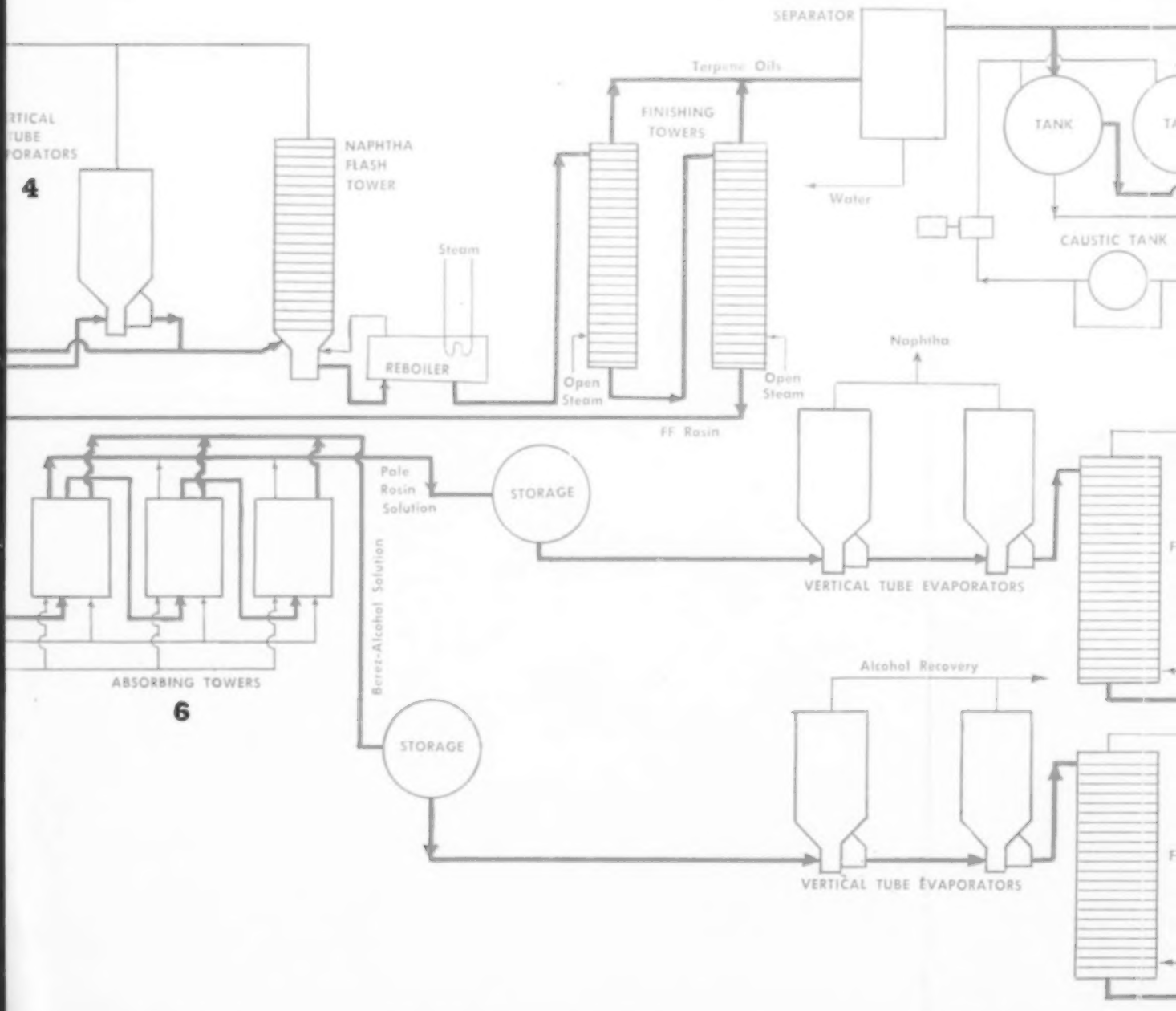
PICTURED FLOWSHEET



6 Rosin-naphtha solution goes through these adsorption towers containing magnesium trisilicate to reduce color of rosin

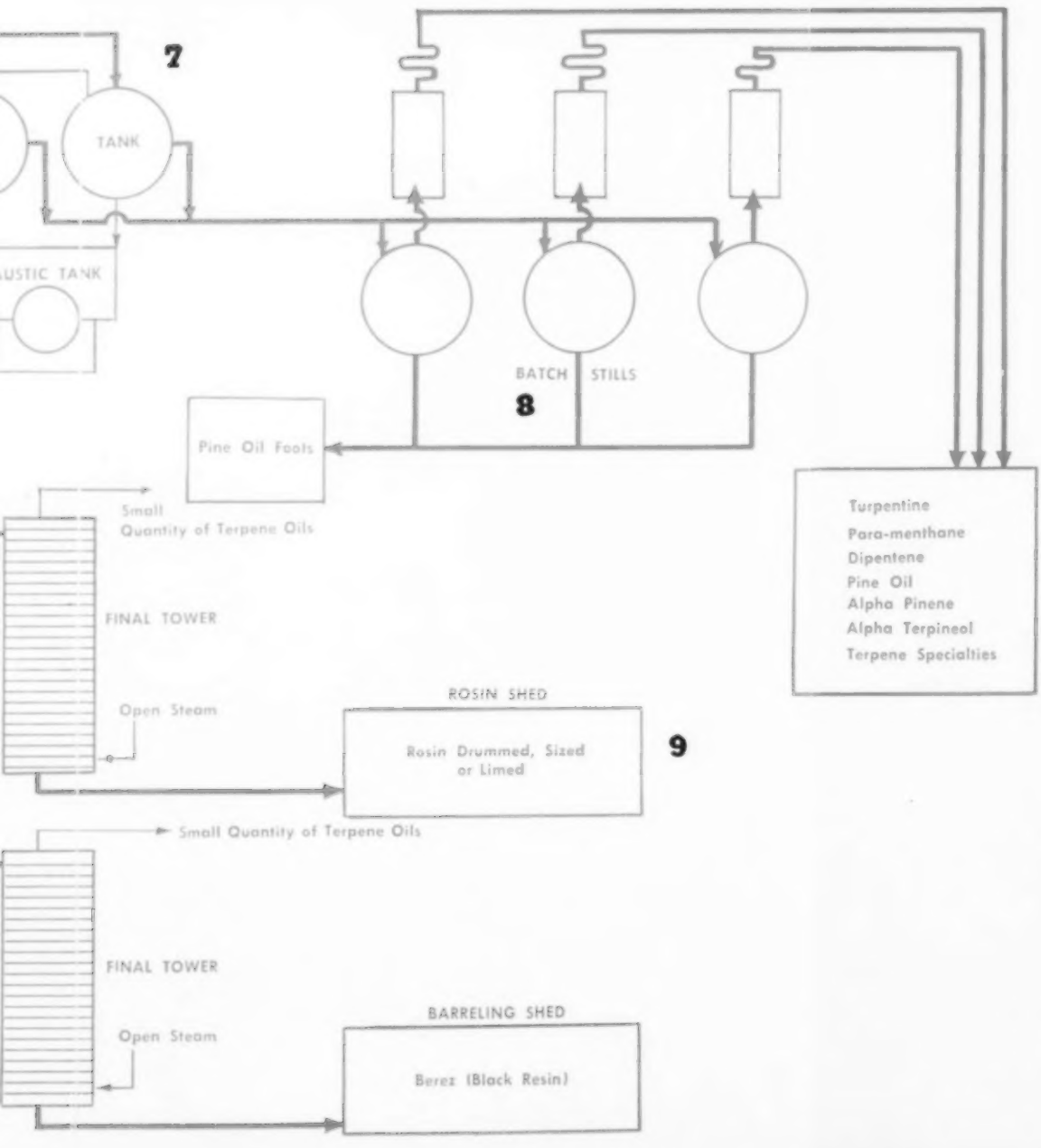


7 To remove aldehydes and improve odor, terpene oil mixture gets washed in these tanks with 20 percent aqueous caustic



8 Terpene oil mixture is distilled in columns in background. Distillate fractions are caught in receivers in the foreground

9 Rosin shed. Finished rosin pumped here is drummed and shipped. Some is limed or made into paper size



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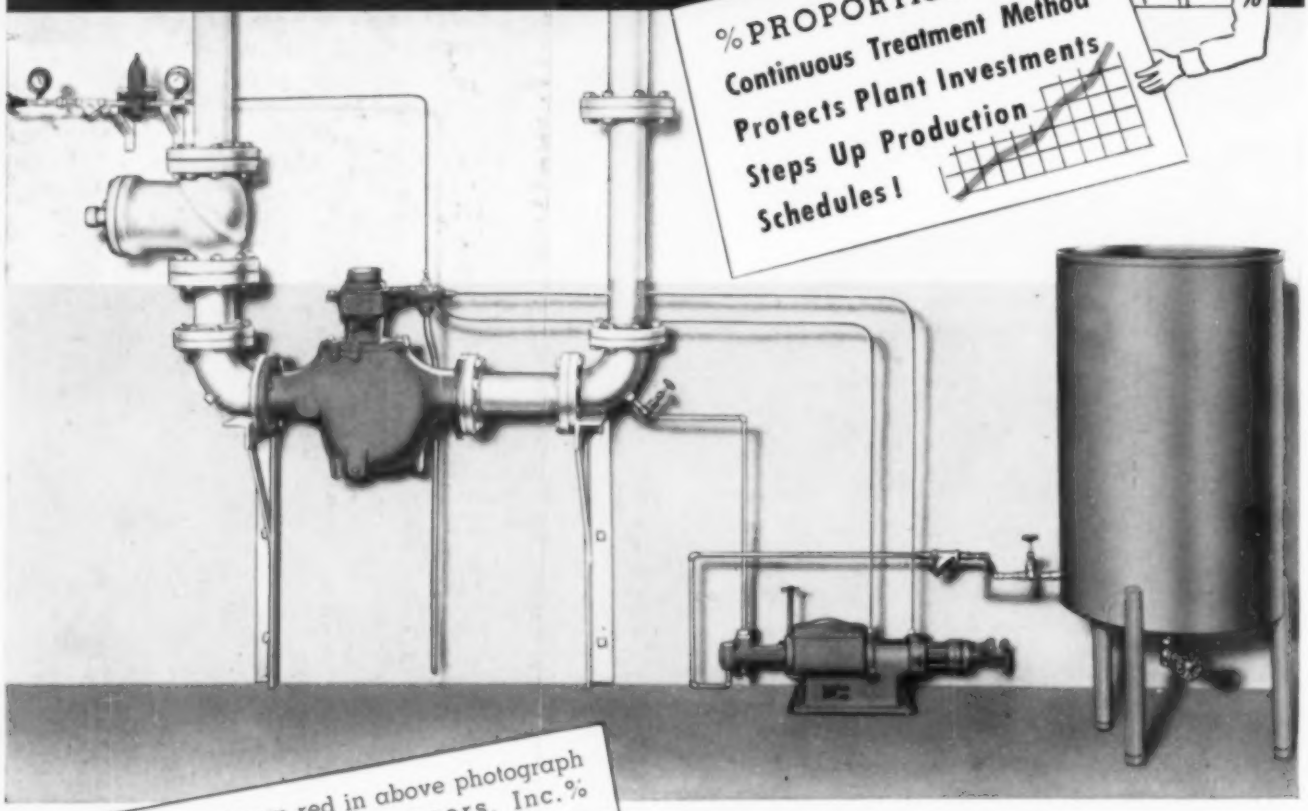

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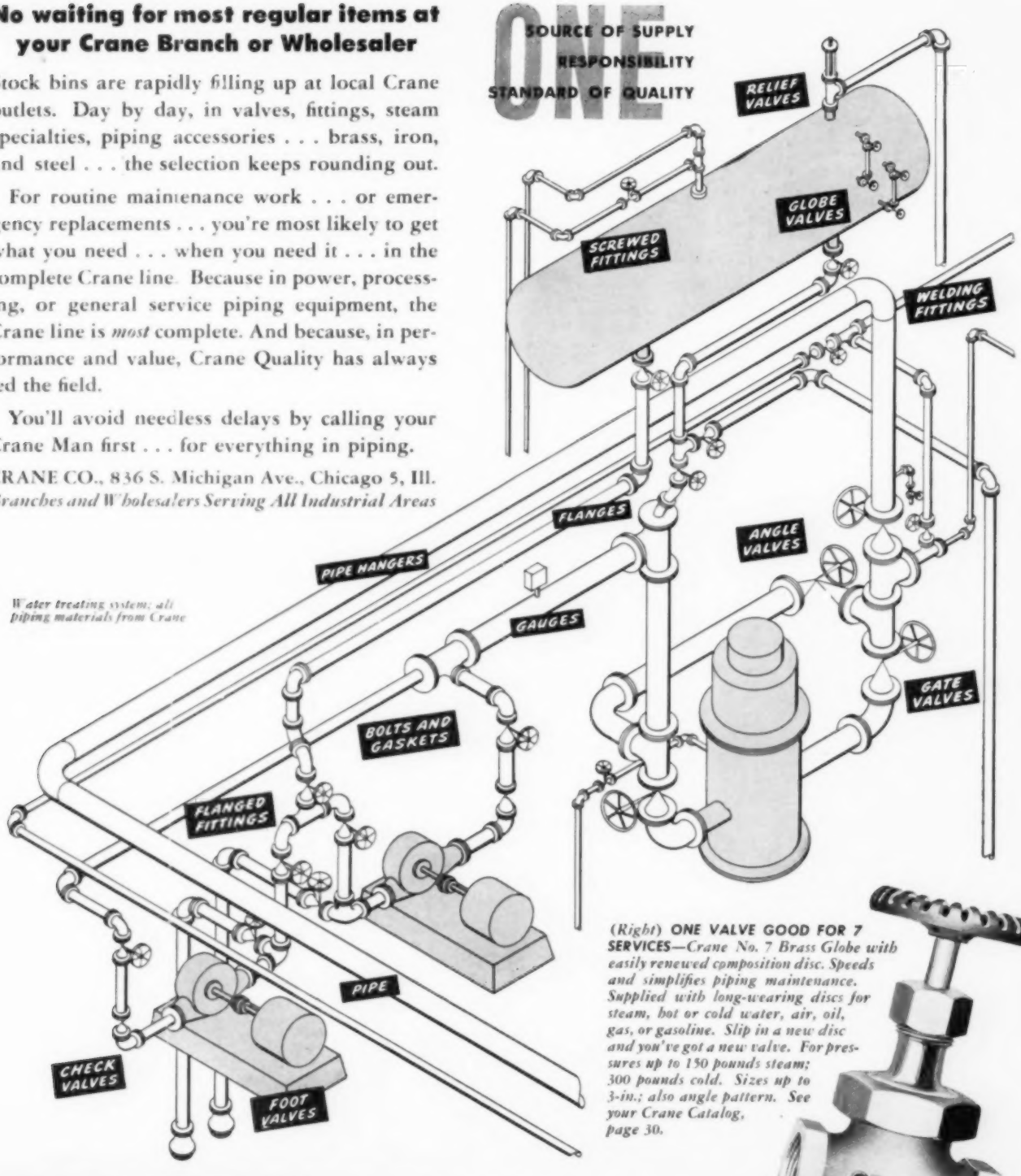
CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY



Water treating system; all piping materials from Crane

(*Right*) **ONE VALVE GOOD FOR 7 SERVICES**—*Crane No. 7 Brass Globe with easily renewed composition disc. Speeds and simplifies piping maintenance. Supplied with long-wearing discs for steam, hot or cold water, air, oil, gas, or gasoline. Slip in a new disc and you've got a new valve. For pressures up to 150 pounds steam; 300 pounds cold. Sizes up to 3-in.; also angle pattern. See your Crane Catalog, page 30.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

SUPERFINE

COLOR GRINDING

with...

Whizzer Separation

ART COLORS
COSMETICS
DRY COLORS
DYE-STUFFS
PIGMENTS
FILLERS

SINCE 1887

Double Whizzer Separator type of Roller Mill for extreme fine pulverizing.

This modern Raymond Roller Mill is an ideal unit for producing various grades of finely ground pigments to maximum specifications.

The mill reduces the material to extreme fineness and uniform particle size, while the whizzer-type separator provides wide range control of classification from 60% passing 100-mesh up to 99.99% thru 400-mesh or better. The mill may be equipped with a throw-out attachment for rejecting hard particles or foreign materials from the grinding chamber, thus refining the product, and reducing mill wear.

The resulting finished material helps to improve the quality of paint mixtures in the form of smooth texture, low oil absorption and increased covering capacity.

White lead, lithopone and titanium pigments, earth colors, chalks, fillers, clays and kaolin, chemicals and similar materials, can be economically produced with the whizzer-type Roller Mill.

Write for detailed information

COMBUSTION ENGINEERING CO. Inc.
RAYMOND PULVERIZER DIVISION

1311 NORTH BRANCH ST., CHICAGO 22, ILLINOIS
SALES OFFICES PRINCIPAL CITIES
CANADA: COMBUSTION ENGINEERING CORP., LTD., MONTREAL

PROCESS EQUIPMENT NEWS

Theodore R. Olive, ASSOCIATE EDITOR

1. Pallet Loader

DESCRIBED by its manufacturer as the "missing link" in a mechanized system of handling packaged items on pallets, a new completely automatic palletizing machine is being offered by Production Aids, Inc., North Hollywood, Calif. The machine takes cases direct from a conveyor line after they have been sealed, and loads them on to empty pallets, cross-tying them whenever necessary to make a complete pallet load, ready to be picked up by a lift truck for warehousing or shipping.

The Pallet Loader is so designed that by the addition of a stack-pattern electrical control unit, a selection of up to 12 stacking arrangements can be obtained by simply pushing a button. Each button operates its particular predetermined stacking pattern, controlling the sequence to be followed by the machine, and arranging the particular stack as to number of boxes per layer, number of rows per layer,

and number of boxes rotated or not rotated per row. It also determines the box spacing, if any, the number of layers, and the height of the stack. Thus many alternate production lines can be switched into a single Pallet Loader. Additional electrical control panels can be added if more than 12 stacking arrangements are needed.

The accompanying view shows the machine, with the entering conveyor and its automatic turntable at the left, the reserve pallet supply in the machine at the lower center, the stacking arrangement being accomplished at the upper center, and a completed pallet being removed on a conveyor at the right. Layers are automatically made up one at a time, then lowered on to a waiting pallet which lowers an amount equal to the height of one carton each time a layer is completed. Then the completed load is removed by conveyor from the machine.

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FOR MORE INFORMATION
See Reader Service
Coupon on pages 173-174

2. Dust Respirator

TO PROVIDE industrial workers with protection against poisonous and disease-producing dusts smaller in diameter than 24 millionths of an inch, American Optical Co., Southbridge, Mass., has announced a new filter

employing a chemically-treated felt filter medium. The filter is said to prevent the passage of dust 40 times more effectively than untreated filters. Known as Model AOR-2000, the respirator is intended for protection against toxic dusts such as lead, cadmium, arsenic, chromium, etc., as well as free silica and asbestos, and nuisance dusts in general. In addition to being more effective, the respirator is said to be lighter in weight and to provide an increased field of vision.

3. Slurry Feeder

TOGETHER with a new stainless steel pressure filter and a new line of diatomite water filtration equipment designed for rapid backwashing, Bowser, Inc., Fort Wayne, Ind., has introduced a new erosion type slurry feeder for mixing a solid with a flowing liquid. This device works on the principle of variable hydrostatic pressure and permits a high degree of control of the powder feed rate. Without moving parts, the powder mass is contained in an upper shell, the bottom of which is formed by two metal cones, one inverted. Four jets of unfiltered liquid fed at 90-deg. angles play upon the

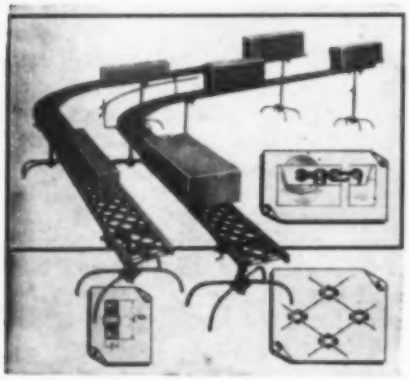
bottom of the mass, eroding the powder. The rate of erosion (feed rate) is controlled by controlling the rate of admission of unfiltered liquid.

4. Temperature Controller

FOR USE with various makes of electric furnaces, ovens, melting pots and other heating devices, the Thermo Electric Mfg. Co., Dubuque, Ia., has introduced a stepless input controller and temperature indicator which regulates current input to the heating equipment by adjusting the "on" time at anywhere from 5 to 100 percent of the total time. The device is independent of line voltage fluctuations, maintaining a constant watt-hour input indefinitely. The instrument is also provided with an indicating pyrometer calibrated to 2,000 deg. F. and 1,100 deg. C.

5. Aluminum Conveyor

EXCEPT for the ball bearings in the aluminum wheels, which are of hardened steel, a new model Load-Veyor introduced by Market Forge Co., Everett 49, Mass., is available in all-aluminum construction. The design is similar to the company's all-steel Load-Veyor, employing the same grid-



like structure which is said to provide greater strength in all directions. Either side of the conveyor can be used—one side with the wheels projecting above the side rails for larger packages, the other side for narrower packages with the wheels below the side rails which then act as guides. A 10-ft. length of the new conveyor weighs only 30 lb., as compared with 58 lb. for the all-steel conveyor.

6. Multi-Deck Sifter

A NOVEL motion of compound gyration in both vertical and horizontal planes is provided in the new Spiro separator offered by Southwestern Engineering Co., 4800 Santa Fe Ave., Los Angeles 11, Calif. This sifter is said to duplicate results obtained in laboratory screening. It provides four screen decks mounted horizontally, and its gyratory motion is said to tumble material over the screen surfaces in a spiral path, completely eliminating dead spots. The motion is adjustable and it is claimed that no vibration is transmitted to the sub-structure.

7. Electric Drying Oven

MECHANICAL convection is featured in a new line of drying ovens, produced in three sizes from 3 to 9 cu.ft., by Electric Hotpack Co., 5031 Cottman Ave., Philadelphia 35, Pa. Heat-resisting glass in the door provides full

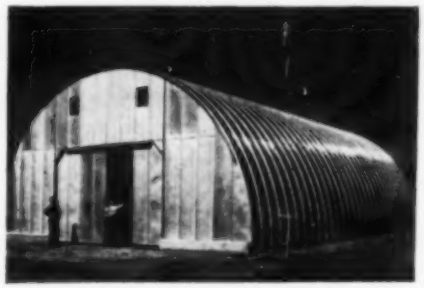
visibility of the work. The oven is equipped for automatic temperature control and can be had in two heat ranges, 180 deg. C. and 260 deg. C.

8. Electric Heaters

TOOLING-UP at its Buffalo plant is now being completed by Yale & Towne Mfg. Co., Chrysler Bldg., New York 17, N. Y., for the manufacture of a complete line of inclosed electric heating units. These will include rod-type units, already manufactured, as well as strip and cartridge types.

9. Aluminum Building

PRE-FABRICATED, self-supporting buildings of the arch roof type are now being made entirely from aluminum by the Reynolds Metals Co., 2500 South Third St., Louisville 1, Ky. While the standardized size of the building is 36 x 60 ft., the construction employs standardized 6-ft. sections which permit the length to be varied as desired. Furthermore, the building can be lengthened at any time simply by adding sections. The individual arch sections can easily be raised into position after assembly on the ground, and are then anchored to a concrete foundation extending 1 ft. above ground level. After the frame is



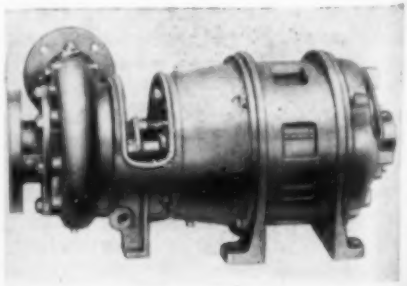
erected, sheathing sheets are attached to the ends and to the curved barrel section. The building is claimed to resist high wind loads, to be fireproof, never to need painting and to reflect up to 95 percent of the solar heat striking it.

10. Strip Chart Recorder

SIMPLE OPERATION without amplification, physical contact or disturbances in the measuring circuit is claimed for the method of recording incorporated in the new electronic recorder introduced by Wheelco Instruments Co., 847 West Harrison St., Chicago, Ill. The new instrument, known as the Capacilog, employs a power-driven pen which is added to the electronic link between measurement and control in both deflection and null type measuring systems. The design is said to be simple. Types are available for any operating current characteristics likely to be encountered. A wide number of models utilizing a variety of control systems is produced for the measurement of temperature by means of thermocouples or resistance thermometers, and for indicating and controlling or recording and controlling.

11. Compact Pump

COMPACTNESS is emphasized in the new line of "Close-Cupld" centrifugal pumps now offered by Goulds Pumps, Inc., Seneca Falls, N. Y. As shown, the pump and motor are combined in a single compact assembly for oper-



This AGITATOR plus This BAFFLE . . .

MEETS PRACTICALLY *Every* MIXING REQUIREMENT!

The *Pfaudler Agitative System* takes the guesswork out of agitation . . . enables you to *predetermine* specifications with simple calculations.

For years, Pfaudler engineers have been classifying mixing actions obtained with various types of glass-covered agitators and adjustable baffles in glass-lined reactors. Through these studies, definite mixing principles have been established as a practical guide in predetermining correct agitation specifications for both pilot plant and full scale operations.

Each factor in agitation—agitative intensity—size of agitator in relation to size of vessel—R.P.M. of agitator—H.P. required—has been worked into three selection charts. Reference to these charts is made in accordance with the type of agitation required—simple blending, heat transfer, suspensions, emulsions, gas absorption, etc.

By cross reference to the charts and with some elementary arithmetic, you arrive at the proper agitation specifications with surprising accuracy. And the use of *standard* Pfaudler equipment keeps costs lower. A full description of the system as well as instructions on how to use the charts are yours for the asking. Use form below.

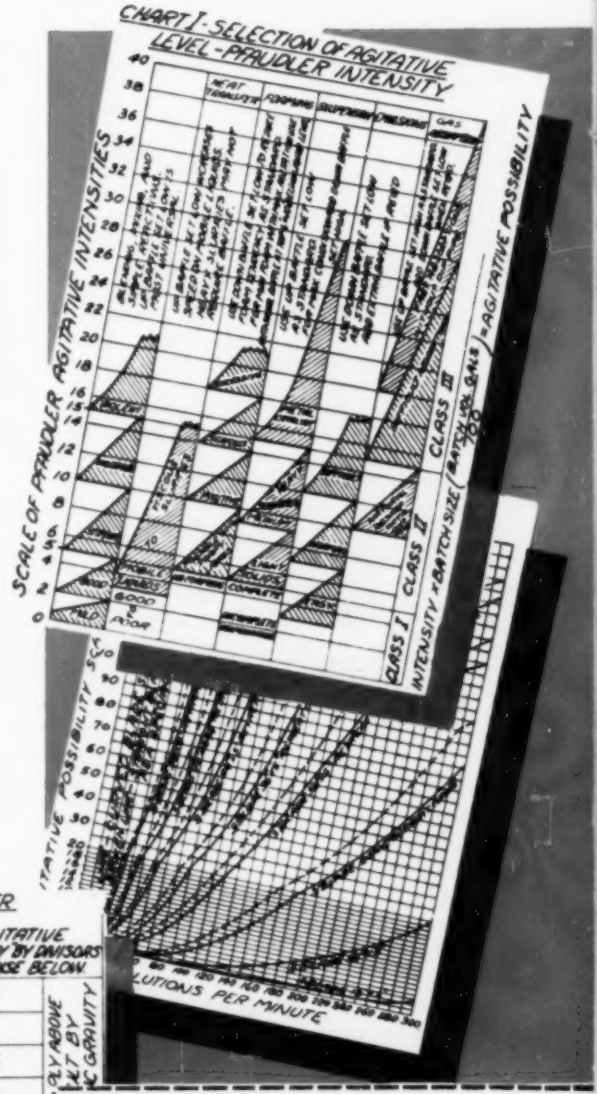


CHART I - SELECTION OF AGITATIVE LEVEL - PFAUDLER INTENSITY
SCALE OF PFAUDLER AGITATIVE INTENSITIES
CLASS I
CLASS II
CLASS III
INTENSITY + BATCH SIZE (BATCH VOL. IN GALS.) = AGITATIVE POSSIBILITY
AGITATIVE POSSIBILITY
REVOLUTIONS PER MINUTE

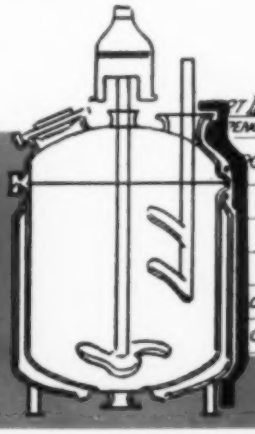


CHART III - TO DETERMINE REQUIRED HORSE POWER

	COMMON MATL @ 68°F	PERCENTAGE OF POWER REQ'D	DIVIDE "AGITATIVE POSSIBILITY" BY DIVISORS FOR CENTIPOISE BELOW
	WATER	100	20
	MED HEAVY MOTOR OIL	105	19
	GLYCERINE CASTER OIL	120	16.6
	KARO CORN SYRUP	150	13.3
	MOLASSES	240	8.3

...BOARD PFAUDLER ...CTORS HANDLE:
...PLE BLENDING
...AT TRANSFER
...PENSIONS
...ULSIONS
...S ABSORPTIONS

...LY ABOVE ...ET BY ...C GRAVITY

THE PFAUDLER CO.
Dept. CE-12, Rochester 4, N. Y.

Send me details covering the "Pfaudler Agitative System."

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COMPANY_____

ADDRESS_____

CITY_____ STATE_____

Pfaudler

THE PFAUDLER CO., ROCHESTER 4, NEW YORK

ENGINEERS AND FABRICATORS OF CORROSION RESISTANT PROCESS EQUIPMENT

Glass-Lined Steel . . . Stainless Steels . . . Nickel . . . Inconel . . . Monel Metal

ation in any position, except vertically with the motor below the pump. A machined stuffing box is employed which permits the use either of a die-formed, semi-metallic packing with lantern type liquid seal rings, or a mechanical seal. An easily removable shaft sleeve is employed, and provision is made for expansion and contraction of this sleeve to prevent buckling and distortion. There are 17 sizes up to 2,000 g.p.m., for heads up to 400 ft.

12. Rubber Curing Truck

SHOWN in the accompanying view is a novel "book truck" designed especially for curing rubber in process and for the production of plastics or other products requiring rapid drying or curing in sheets. Manufactured by the

Palmer-Shile Co., 12606 Mansfield Ave., Detroit 27, Mich., the truck is of welded steel construction, provided with extension springs to permit easy raising and lowering of the individual shelves. The shelves are automatically held up in the tilted position for easy loading.

13. Air Conditioner

INTENDED for use where highest precision air conditioning is needed for scientific and industrial applications, the new Type A machine introduced by Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y., is of the saturating spray type, operating on the principle of saturating air with moisture at a given desired dew point temperature, and then by reheating, producing the exact condition of relative humidity and temperature required. The new conditioner employs new designs of cooling and heating coils and a spray arrangement said to give great turbulence, achieving saturation of air in an exceedingly small floor space. The 2,000 cu.ft. per min. unit illustrated occupies only 7½ sq.

ft., while a 20,000 cu.ft. per min. unit requires only 50 sq.ft. of floor area. The unit is said to hold, or vary at will, any desired conditions of relative humidity and temperature between 40 deg. F. and 125 deg. F. dew point temperature with extremely close tolerance. Lower temperatures can be obtained by using this company's "No Frost" liquid in the spray solution.

14. Self-Aligning Idlers

TWO IMPROVED types of self-aligning idlers for belt conveyor service has been announced by the Jeffrey Mfg. Co., Columbus 16, Ohio. The

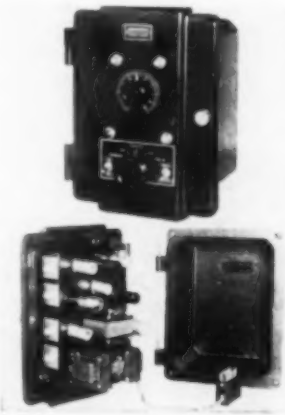
accompanying illustration shows the positive type self-aligning idler equipped with guide rollers (above), and the self-aligning idler with flared, friction-type end pulleys (below). The latter type is particularly adaptable for reversible belts.

15. Thawing Equipment

SEVERAL new models of oil-fired thawing equipment, burning either kerosene or light furnace oil, have been announced by Hauck Mfg. Co., 124 Tenth St., Brooklyn 15, N. Y. Among these are a single and a double burner type wheeled model, each provided with a 20 gal. fuel tank and with 12 ft. lengths of oil hose. The flame from each burner is said to be 4½ x 42 in. in size, and of a temperature of 2,000 deg. F. A new ground-thawing machine for construction work consists of a hood covering a 42 x 24 in. area and provided with a burner and handles for ready movement.

16. Electronic Servo

FOR REMOTE control and positioning of valves, dampers and other mechanical mechanisms, Askania Regulator Co., 240 East Ontario St., Chicago 11, Ill., is now producing an electronic servo system consisting of a transmitter, a control amplifier and a receiver. The first unit picks up the control impulse, the second responds to this impulse, amplifies it and con

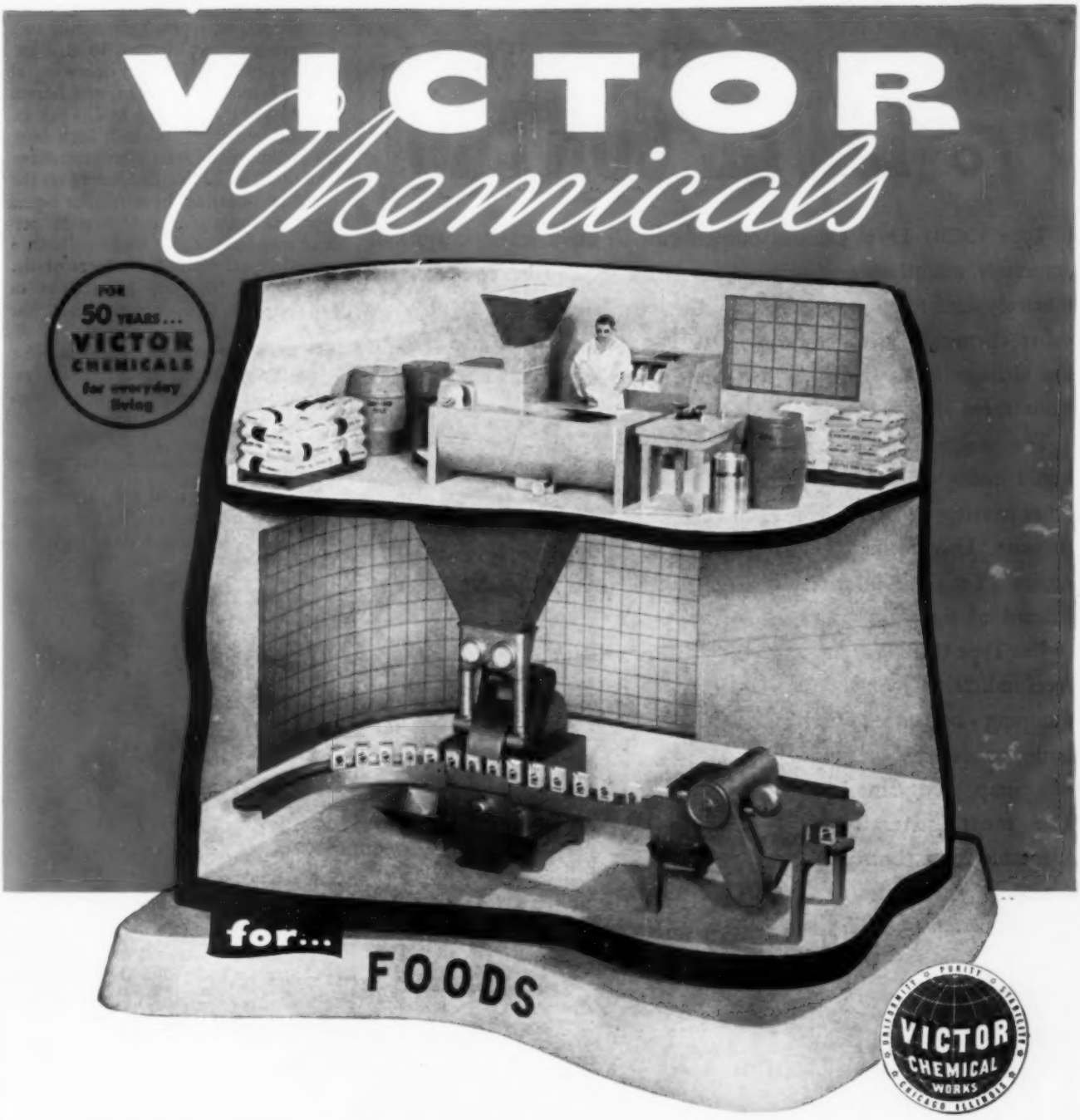


trols the supply of power to the receiver, and the receiver itself moves the remotely controlled device to the selected position. It is claimed that the new system, although heavily constructed for industrial use, provides a degree of accuracy ordinarily available only in laboratory instruments.

17. Gelatinizing Roll

FOR THE drying and processing of starch products, as well as a variety of other high moisture content materials requiring drying and flaking, Allis-

VICTOR Chemicals



Victor Phosphates play important and varied roles in the manufacture and enrichment of food products. Cereals, flour, prepared mixes, and food beverages, for example, are enriched with essential calcium, phosphorus, and iron by the addition of Victor Calcium and Iron Phosphates. Calcium phosphates also provide the necessary leavening acid in prepared flour mixes. Disodium phosphate serves as an emulsifier in the production of process cheese and condensed milk. ¶ Victor chemicals employed in the food industry include: **Ammonium Phosphates** (yeast, vinegar, yeast food), **Dicalcium Phosphate** (mineral fortification), **Disodium Phosphate** (process cheese, condensed milk), **Hicalcium Phosphate** (calcium-enriched flour and bread), **Iron Phosphates** (mineral enrichment), **Monocalcium Phosphate** (mineral supplement, leavening acid, baking powder), **Phosphoric Acid** (yeast, sugar, soft drinks, imitation jellies, gelatine), **Sodium Acid Pyrophosphate** (acid ingredient in commercial baking powders, prepared doughnut and cake flours), **Tricalcium Phosphate** (conditioning salt, soda, and powdered sugar).

VICTOR CHEMICAL WORKS, 141 W. Jackson Blvd., Chicago 4, Ill.

NEW YORK • KANSAS CITY • ST. LOUIS • NASHVILLE • GREENSBORO, N. C

Plants: NASHVILLE • MT. PLEASANT, TENN. • CHICAGO HEIGHTS, ILL. • VICTOR, FLA

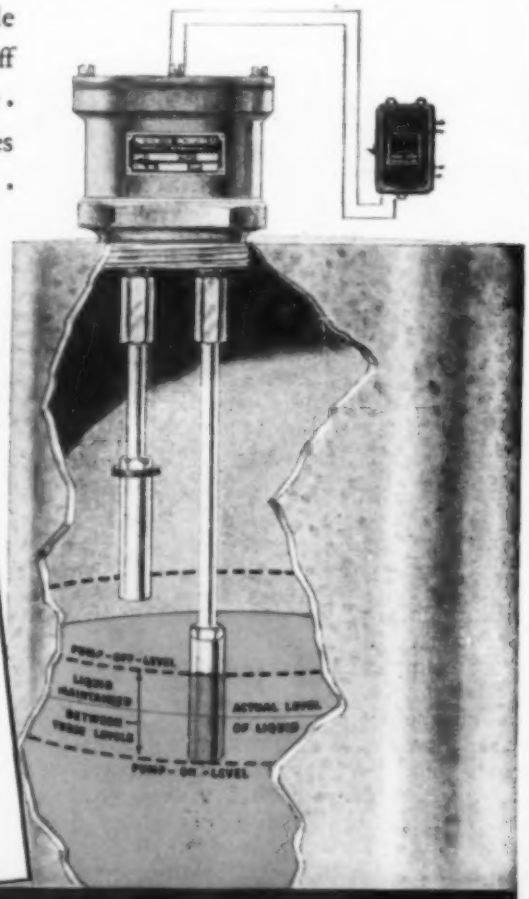
NEW PHOTOSWITCH
LEVEL CONTROL

Type 10CB1 Level Control outperforms all other level controls. It accurately maintains *predetermined* levels for liquids or powders. Extensively used for control of water, milk, beer, acids, caustics and most other chemicals in Chemical Process, Food and Sewage fields when the ultimate in control is desired. Special fittings for sanitary installations meet all health board requirements.

The unique principle of Photoswitch design permits contact with liquid under control only by stainless steel probe rods. No floats or other moving parts required. Accuracy independent of temperature and pressure. Low voltage A.C. in probe circuit prevents electrolytic action. Yet amplification through power circuit gives positive control of signals, valves or pumps.

Use Type 10CB1 for single level indication • on-and-off pumping • boiler feed water • boiler condensate • all types of pump programming • The most generally adaptable level control available.

Send for bulletin #201P.



MAINTENANCE—FREE

- NO MOVING PARTS
- NO FLOATS
- NO STUFFING BOXES
- NO BELLOWS SEALS
- NO VACUUM TUBES
- NO MAINTENANCE

PHOTOSWITCH
INCORPORATED
Photoelectric & Electronic Controls for Every Industrial Purpose
77 BROADWAY CAMBRIDGE 42, MASS

Chalmers Mfg. Co., Milwaukee, Wis., has introduced a new gelatinizing roll. The machine employs two 36-in. diameter by 84-in. long rolls operating at speeds from 5 to 20 r.p.m. and heated by steam at pressures up to 225 psi. ga. It is designed for unusually high bearing pressures and for a power consumption of 10 to 20 hp., depending on the speed and bearing pressure. For liquid products containing as high as 80 percent moisture, it can be fitted with a special liquid feeder. Features of the design include ready adjustment of roll pressure and doctor blades, the latter being readily removed for regrinding. The roll shells are cast of a special alloy metal said to have excellent wearing properties and a high coefficient of heat transfer.

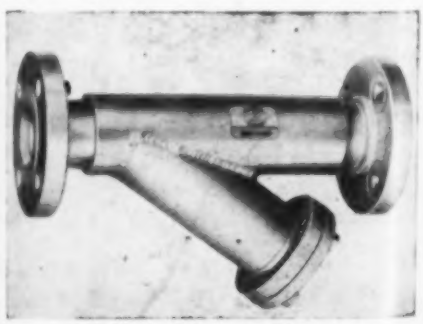
18. Dry Chemical Extinguisher

MODEL 4 is a new 4-lb. dry chemical fire extinguisher carrying the necessary approvals which has been announced by the Fire Extinguisher

Division of Ansul Chemical Co., Marinette, Wis. It is suitable for extinguishing fires in flammable liquids, gases, solids and electrical equipment, as well as for controlling fires in ordinary combustibles.

19. Stainless Strainer

FOR RESISTANCE to a variety of corrosive liquids and gases, Standard Machine & Mfg. Co., 8213 Gravois Ave., St. Louis 23, Mo., has introduced a



No "HAND-ME-DOWNS" at MOSINEE

It is the MOSINEE policy to create *custom-made* papers *only* . . . custom-made to fit our *customers' specific requirements.* There are no "stock runs" of general-purpose papers at MOSINEE . . . no "hand-me-downs" or attempts to sell you a standard paper rather than the "made-to-order" type that is essential to the functions you want paper to perform in your products and processing.

MOSINEE paper technicians cooperate in determining *what* you need in paper, and *how* you can process it best . . . then MOSINEE makes paper according to *your* needs. MOSINEE has the experience plus scientific and production controls for moisture repellency, specified dielectric strength, high tensile strength, folding, maximum-minimum pH and other vital characteristics of modern industrial papers.

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PROBLEMS
Centrifugal Blower with capacity of 16,740 CFM, direct motor driven.
Rotary Positive Blowers are available in a wide range of capacities, from 5 CFM up.

That's important—our *dual-ability* to supply either Centrifugal or Rotary Positive Blowers. It means that our recommendations are always unbiased. We suggest the equipment that experience has proved will beat meet the specific conditions.

In the chemical industry, many factors influence this decision. Capacities, pressures, drives, dimensions, weight and other characteristics are carefully considered. First cost, operating economy and deliveries are important points.

Our wide experience enables us to make sound recommendations. The accuracy of our engineering and sturdiness of our blower construction have been proved for many years.

The first Rotary Positive Blower built by anyone was produced in the "Roots" plant in 1854—six years before the first pony express. We're not good because we're old, we're old because we're good!

For practical, up-to-date answers to your blower problems, you can depend on R-C *dual-ability*.

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712 Illinois Ave., Connersville, Ind.

ROOTS-CONNERSVILLE
ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS

• • ONE OF THE DRESSER INDUSTRIES • •

FOR MORE INFORMATION
See Reader Service Coupon on pages 173–174

new line of Y and angle type pipeline strainers fabricated entirely of stainless steel. Screens are produced in all meshes, either in wire mesh or perforated metal, seam-welded to prevent bursting at elevated pressures. The sizes range from 2 to 6 in. i.p.s.

20. Submerged Pump

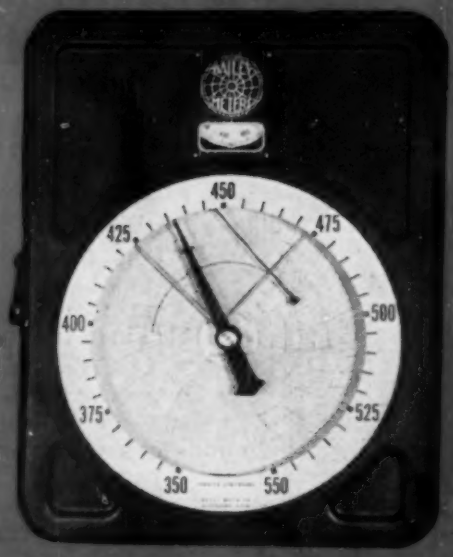
FOR APPLICATIONS requiring a pit type pump without a submerged bearing, Nagle Pumps, Chicago Heights, Ill., has introduced the Type SW-O overhead-bearing pump illustrated, in which the anti-friction bearings are

supported in a pedestal attached to the floor plate. The new construction is said to be ideal for heavy liquids, hot liquids (up to 1,000 deg. F.) or for liquids containing solids. A modified type has the suction on the bottom for handling mixtures containing quick settling solids. Neither type requires a stuffing box.

21. Seatless Valve

SEVERAL NOVEL features are incorporated in the new "20th Century

3 WAYS to CONTROL TEMPERATURE



WITH BAILEY PYROTRON ELECTRONIC RESISTANCE THERMOMETERS

1. FOR AIR-OPERATED SYSTEMS

A free floating air pilot valve actuated by the Pyrotron slidewire unit establishes an air loading pressure for the control of valves and drives. Adjustments and relays provide flexibility of range, sensitivity, and speed of response, as well as reset action, easy coordination with other factors, and remote manual control.

2. FOR ON-OFF ELECTRICAL SYSTEMS

By Electronic Relay—Two slidewires, one set manually to the desired temperature standard by a convenient knob and scale, and the other automatically positioned by the Pyrotron slidewire unit, form a control bridge which operates an electronic relay.

By Electric Contacts — Adjustable cam on Pyrotron slidewire unit operates a totally enclosed snap switch.

3. FOR MODULATED ELECTRONIC SYSTEMS

A control bridge formed by two slidewires establishes a small signal voltage which changes in phase and intensity to operate a standard electronic control unit. The d-c output of this unit is accurately regulated according to the signal and applied to a saturable core reactor to vary voltage on the a-c heating circuit.

UNUSUAL FEATURES OF THE BAILEY PYROTRON ELECTRONIC RESISTANCE THERMOMETER

1. Resists vibration and shock.
2. Needs no careful leveling.
3. Motor drive provides abundant power for operation of recording pen, controller, alarms and signals.
4. Simple a-c measuring bridge needs no battery.
5. Sturdy electronic units keep the bridge in continuous balance and replace the usual galvanometer and its attendant mechanism for step by step balancing.
6. Interchangeability of packaged units simplifies replacement.

For details on this unusual Electronic Resistance Thermometer, which indicates, records and controls temperatures between —100°F. and 1200°F. ask for Bulletin 230-A. P-10

BAILEY METER COMPANY

1054 IVANHOE ROAD • • • CLEVELAND 10, OHIO

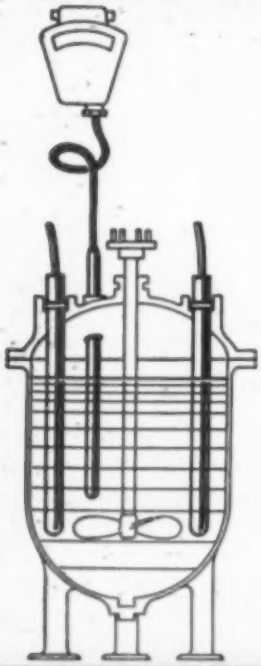
Controls for Processing

TEMPERATURE FLOW
PRESSURE LEVEL
% OXYGEN DENSITY
% COMBUSTIBLES RATIO

*Amersil** IMMERSION HEATERS

specifically designed for

CHEMICAL PLANT WORK



offer the following advantages over conventional construction:

- **High heat efficiency.**
- **Rapid evaporation due to high heat transfer rate—up to 200 watts per square inch of heater shell surface.**
- **A minimum of obstruction due to compactness.**
- **Are chemically resistant to highest concentration of acids at high temperatures.**
- **With enclosed thermal element extremely accurate heat control is maintained.**
- **Quickly and easily installed.**

Write to Amersil, Department "C" for more complete details, or ask for latest printed matter.

**Trade Name Registered*

AMERSIL COMPANY Inc.

ENGELHARD

CHESTNUT AVENUE — HILLSIDE 5, N. J.

THIS IS THE PUMP FOR YOUR "DIRTY WATER" JOB

It is the LAWRENCE CENTRIFUGAL, side-suction type, that is perfectly at home handling water that carries dirt, ash, pulp, trash or what-have-you, in suspension—stuff that would "choke" any ordinary pump. Obviously, then, it is the pump to use for such service as handling "white water" in pulp and paper mills, wash water in coal washing plants, mixtures in tanneries, textile plants and sugar mills, and similar "dirty" jobs. If you have a pumping job of this kind—or any pumping job involving difficulties—ask our experienced engineers for their suggestions and assistance. There's a LAWRENCE CENTRIFUGAL for every purpose.

HORIZONTAL

LAWRENCE PUMPS

VERTICAL

SINCE 1862

LAWRENCE MACHINE & PUMP CORP.

369 Market Street, LAWRENCE, MASS.

LAWRENCE CENTRIFUGALS

FOR EVERY PUMPING DUTY

Seatless Valve" recently announced by Knowles-Fisher Corp., Gowanda, N. Y. The valve has no valve seat, washer or wearing parts, and no packing gland. It is claimed that it cannot jam, leak or chatter. The design consists of a polished stem, engaging two wear-resistant synthetic rubber collars, one at each end of the valve. In opening, the stem is withdrawn from the lower collar and is retracted into the upper collar which forms a seal and prevents liquid from entering the activating threads.

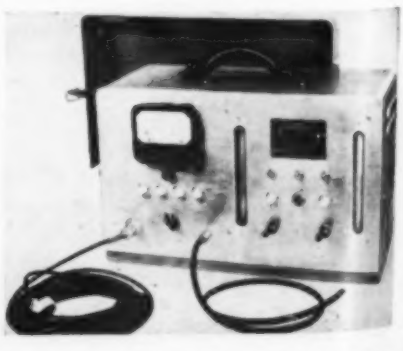
22. Elevator-Dumper

FOR DUMPING a wide variety of free-flowing materials into bins, kettles or other process equipment, the Colson Equipment & Supply Co., 1317 Willow St., Los Angeles 13, Calif., has

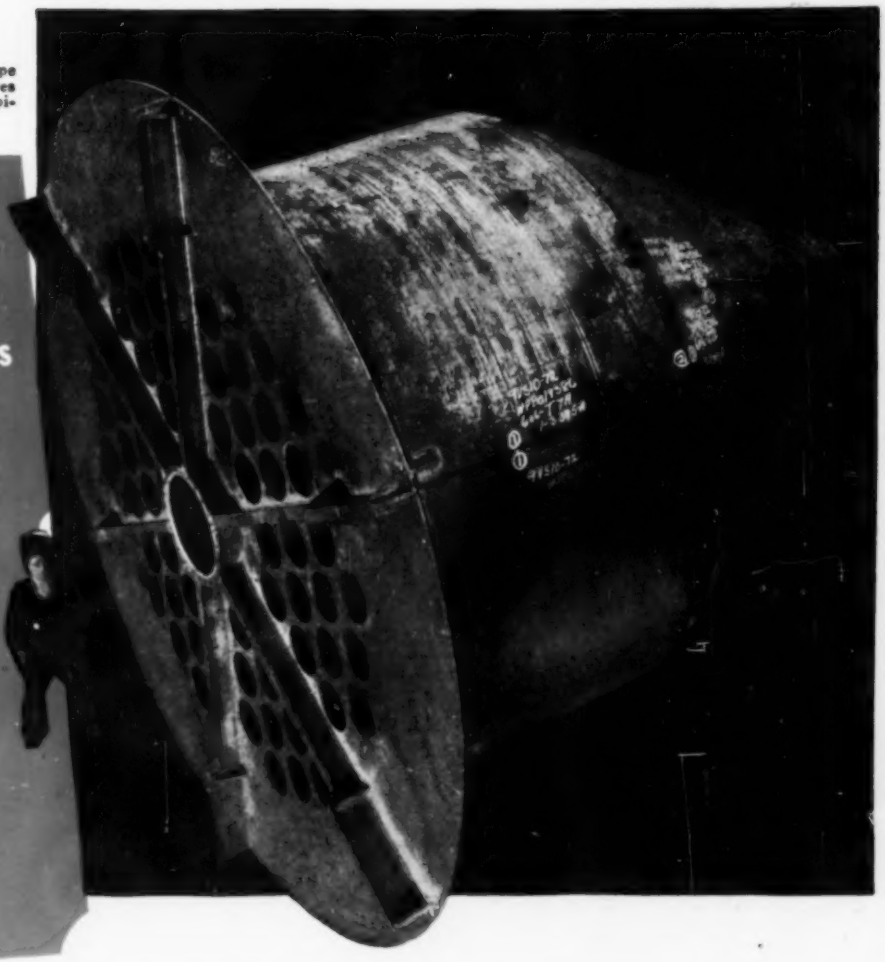
introduced the **Cesco dumper**, a miniature portable skip hoist. The material to be elevated is placed in the skip, a switch is turned, and the skip with its load is automatically lifted and emptied into the receiving vessel. With a capacity of 500 lb. of loose material or liquid, it is claimed that as many as 100 trips per hour can be made. Four dumping heights of 5, 6, 7 and 9 ft. are available.

23. Toxic Gas Analyzer

FOR DETERMINING and analyzing the concentration of gases or vapors



UOP Multiclones, of U·S·S 12 (Type 410) Stainless Steel, fabricated by Des Moines Steel Co. for Western Precipitation Corporation.



In pressure vessel linings

In bubble caps and trays

In multiclone precipitators

In heat exchanger tubes

In flue gas recirculation systems

In high temperature air preheaters

In pumps, liners, orifice plates

In furnace tubes and dampers

—nothing equals Stainless Steel

WHEREVER corrosion resistance is of paramount importance in your refinery equipment the use of Stainless Steel is indicated. This is especially true today when the higher pressures and higher temperatures being employed to obtain better yields are greatly increasing the severity of corrosive action.

Laboratory and field tests show that in general the corrosion resistance of steel equipment increases with increasing chromium content. The U·S·S Stainless and Heat Resisting Steels recommended for refinery service contain from 4% to 27% of chromium.

This *complete* family of service tested steels thus affords the refining engineer a selection of materials with which he can more effectively solve his most difficult corrosion, heat and pressure problems. With them he can not only retard equipment deterioration but hold product losses to a minimum. They insure greater freedom from contamination. They reduce plant shut-downs and process interruptions due to corrosion failures. They increase safety wherever corroding equipment can cause fairly harmless compounds to become explosive.

Our stainless steel specialists will gladly help you select the grade of U·S·S Stainless that will meet your requirements most efficiently and economically. It will pay you to talk things over with them.

USS STAINLESS STEEL — UNITED STATES STEEL

U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

7-1473

UNITED STATES STEEL AMERICAN STEEL & WIRE COMPANY, Cleveland, Chicago & New York
CARNEGIE-ILLINOIS STEEL CORPORATION, Pittsburgh & Chicago · COLUMBIA STEEL COMPANY, San Francisco
NATIONAL TUBE COMPANY, Pittsburgh · TENNESSEE COAL, IRON & RAILROAD COMPANY, Birmingham
UNITED STATES STEEL SUPPLY COMPANY (Warehouse Distributors), Chicago · UNITED STATES STEEL EXPORT COMPANY, New York

fast fire protection on wheels!

There are probably areas in your plant, remote from each other, which require more than ordinary fire protection: baking and drying ovens, dip tanks, pump houses, solvent baths, spray rooms, transformers, circuit breakers and other electric apparatus.

Large volume, highly mobile C-O-Two Wheeled Portables are especially designed for big, widely scattered hazards. They bring powerful fire protection on the spot in a hurry. Equipped with our famous Squeez-Grip release, C-O-Two Wheeled Portables blanket fire with clouds of dry, non-damaging carbon dioxide gas-and-snow, expanded 450 times its liquid volume. Seconds later the fire's out, and C-O-Two disappears without a trace.

C-O-Two is a modern fire fighter. It's fast, safe, non-conducting, non-corrosive, harmless to equipment and materials.

Our expert engineers will help you plan complete C-O-Two fire protection for your property. Write us today for your free catalog.

The C-O-Two Wheeled Portable is again available equipped with or without metal protective covers for horn and hose, and with steel wheels or rubber tires.

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1, N. J.

Sales and Service in the Principal Cities of U. S. and Canada
AFFILIATED WITH PYRENE MANUFACTURING COMPANY

in their toxic range, Davis Emergency Equipment Co., 45 Halleck St., Newark 4, N. J., has introduced a new Micro-Gas analyzer working on the principle of electrical conductivity of solutions. Any gas which will ionize in water may be analyzed in the toxic range. This includes all chlorinated hydrocarbons, carbon bisulphide, hydrogen sulphide and sulphur dioxide. The instrument operates by decomposing a fixed flow of gas in a combustion chamber, then dissolving the decomposed gas in water and measuring the electrical conductivity. A meter reads directly in parts per million of the gas being analyzed.

This manufacturer has also introduced a new combustible gas alarm system which detects the presence of combustible vapor or gas and gives an audible signal before the mixture becomes dangerous.

Equipment Briefs

24. MADE IN sizes from ¼ to 2 in., a new acid-resisting safety and relief valve for the handling of corrosive vapors and gases has been introduced by Farris Engineering Corp., 58 Commercial Ave., Palisades Park, N. J. Hastelloy-C is used for the nozzle and valve disk and in some models for the complete valve body. Isolation of all working parts of the fluid handled is accomplished by a flexible seal.

25. SCALE MODELS of complete chemical plants for engineering purposes are being constructed by Industrial Models, Arden, Wilmington, Del. The model is built from flowsheets or blueprints as the plant is being designed and can include all structural members, equipment, piping, valves, instruments, etc. It can be used first by the plant designers in visualizing alternate layouts, later by the construction men, and finally by the operations department in training operating labor.

26. INDUSTRIAL aluminum roofing and siding, made from a special aluminum alloy, has been introduced by the Aluminum Co. of America, Pittsburgh 19, Pa., to supplement the standard roofing sheets already employed extensively in farm building. The new material has a covering width of 32 in. and is said to combine high strength with exceptionally high resistance to industrial atmospheres.

27. TO PERMIT the calibration of cathode-ray oscillographs so that they may be used for quantitative measurements, the Allen B. DuMont Laboratories, 1000 Main Ave., Clifton, N. J., has introduced the Type 264-A voltage calibrator, a low-cost device which

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—PLANE
—OR SHIP TO
—WHOLESALER
—RETAILER
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your product needs and deserves the extra margin of safety in Gaylord Boxes that comes from correct functional design, better materials, and precision manufacturing.

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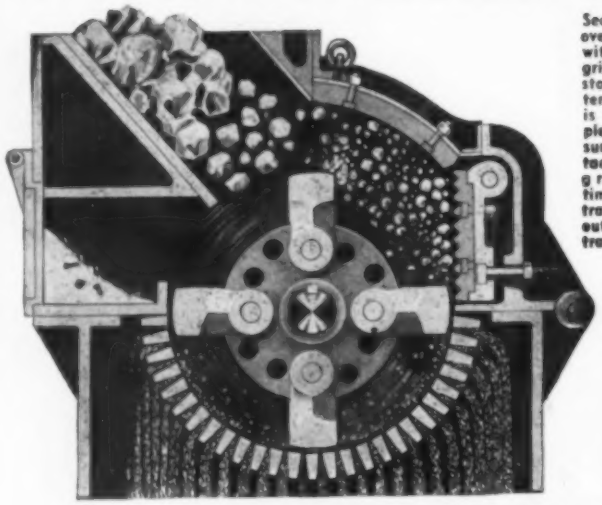
147

Williams

OLDEST AND LARGEST BUILDERS OF HAMMERMILLS IN THE WORLD

PATENT CRUSHERS GRINDERS SHREDDERS

HEAVY DUTY HAMMERMILLS



Sectional view of Williams over-running hammermill with heavy liners and grinding plate for limestone and other hard material. Particular attention is directed to the grinding plate adjustment which assures uniform close contact of hammers and grinding plate at all times. Also note the metal trap which provides an outlet for the escape of tramp iron.

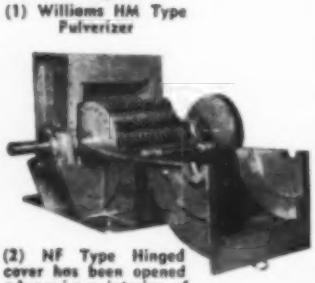
Reduces

ANIMAL
MINERAL
VEGETABLE
MATTER

STANDARD MACHINES for Practically Any Reduction Job

(1) Williams HM Type Pulverizer

CHEMICALS, SOAP CHIPS, ETC. Hundreds of chemicals are being ground with the machines shown here.



(2) NF Type Hinged cover has been opened showing interior of mill.

OIL CAKE, INCLUDING SOYA, COPRA AND COTTONSEED. Expeller cake as well as hydraulic press cake is satisfactorily ground for animal food.

ANIMAL AND FISH BY-PRODUCTS. Thousands in operation grinding cracklings, tankage, fish scrap, raw and dry bones, etc.

(3) Another view of NF Type. Notice heavy flywheel at right.

GARBAGE, SEWAGE. Many in operation grinding garbage from municipalities and canneries.

STEEL, ALUMINUM AND OTHER METAL TURNINGS. All can be easily handled in Williams Mills to permit easier handling by conveyor or shovel.

ROOTS, HERBS, BARK AND CHIPS. Various vegetable substances can be successfully shredded previous to extraction processes.

THE WILLIAMS PATENT CRUSHER & PULVERIZER CO.

2706 North Ninth St. St. Louis, Mo.

Sales Agencies Include

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37 W. Van Buren St.

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15 Park Row

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FOR MORE INFORMATION
See Reader Service
Coupon on pages 173-174

permits measurements to be made of any part of a complex composite wave form. The instrument may be used in conjunction with any commercial cathode-ray oscillograph.

28. EXHIBITED at the recent second annual instrument conference and exhibit, held in Chicago, was a new line of instrument air dehydration equipment introduced by Dehydraire Corp., 14-13 118th St., College Point, New York. These dryers range in capacity from 12½ to 250 std. cfm. of air at 100 lb. pressure and 70 deg. F., such capacities providing dry air for from 25 to 500 air-operated instruments. A final dew point as low as minus 50 deg. F. is produced.

29. COMPUTATION of orifice plate bores, flow nozzles, venturi throats and rates of flow or differential created across a variety of primary flow measuring devices, is accomplished readily by a new 12-in. slide rule for flow problem calculations offered by the Foxboro Co., Foxboro, Mass. The new Flow-Rule is constructed of moisture-proof plastic and requires no adjustment by the user for clearance or alignment.

30. AN IMPROVED change can mixer for pastes as well as liquids, provided with a speed range from 42 to 146 r.p.m., has been announced by Allied Steel & Equipment Co., 1007 Springfield Ave., Irvington, N. J. The mixer provides four mixing speeds, is equipped with a 5-hp. motor, and a triple V-belt drive, and uses a hand winch to raise the mixer. The 150-gal. can is mounted on casters. It is provided with a removable handle.

31. FOR EXTREMELY high evacuating capacities, 8,500 c.f.m. at 0.1 micron, the H-16 all-metal, three-stage oil diffusion pump has been added to the line of National Research Corp., Cambridge 42, Mass. The pump works against any fore pressure as high as 250 microns, eliminating the need for a booster in this application. The inlet diameter is 16 in., the overall height only 56 in. Construction materials include spun aluminum jets, with other parts of stainless steel. Heat for vaporizing the oil is provided electrically, with a heat input of 2,250 watts.

NEW PRODUCTS AND MATERIALS

Richard W. Porter, ASSISTANT EDITOR

51. Silica Powder

MICROSCOPIC fineness and a high degree of chemical purity should provide the new silica powder of Linde Air Products Co., 30 East 42nd St., New York, with a number of uses associated with surface phenomena. Sold under the company name, Linde, the silica powder is being produced in pilot plant quantities. It forms stable suspensions in water and in many organic liquids. Proper selection of concentrations leads to the formation of stable or thixotropic gels, dilatant liquids and other colloidal systems.

Greater strength and improved pigment dispersion result, according to the manufacturer, when this silica powder is added to many plastic materials. A white amorphous powder, its physical properties include: particle diameter, 50 millimicrons maximum; oil absorption (ASTM), 400 (linseed oil); bulk density, 2.3 lb. per cu.ft. (not densified); true density, 2.2. g. per cc.; index of refraction, 1.46; purity (dry basis), 99.9 percent; adsorbed water, 8 percent maximum. One, five and ten pound lots are now available. It is suggested for use as a catalyst carrier, as an ingredient in paints, varnishes and lacquers, as a compounding and reinforcing agent in rubber and in various other products.

52. Rubber Substitute

A VULCANIZED petroleum oil derivative of tough, rubbery consistency similar to other rubber substitutes is being produced by Amecco Chemicals, Inc., Henderson, Nev. Called Flextender 3-A, it may be used as a rubber substitute and processing aid for natural and synthetic rubbers and vinyl copolymers. Specific properties: color, black; total sulphur, 12 percent; free sulphur, 1.6-1.7 percent, and acetone extract, 38-42 percent. The product is compatible with natural rubber, butadiene-acrylonitrile, butadiene-styrene copolymers, Neoprene and vinyl copolymers. Tack characteristics which disappear on curing are imparted to uncured stock and good ageing is exhibited. It is suitable for use in extruded stocks, flooring compounds, mid-soling compositions and molded specialties. Plasticizing action is illustrated when various proportions are added to natural rubber.

At optimum cure, 20 parts extender to 100 parts rubber produces material with 2,480 psi. tensile strength and 700 percent elongation; with 40 parts, 2,000 lb. per sq.in. and 720 percent, and with 40 parts in a stock loaded with 50 parts clay, 2,080 lb. per sq.in. and 620 percent. Added to Neoprene, 40 parts of the new extender gives a material with 1,480 psi. tensile strength and 900 percent elongation. Properties hold up well after accelerated heat ageing at 310 deg. F. Tests indicate the extender does not exert a pronounced softening action. Used in vinyl copolymers, maximum compatibility is in the range of 25-50 parts addition. With this latter material, a solvent-type plasticizer is required along with Flextender 3-A for good physical properties.

53. Sodium Carboxymethylcellulose

LAUNDERING performance equaling that of the best grades of soap is claimed for Carbose, a technical grade carboxymethylcellulose, when in combination with certain synthetic detergents. It is manufactured by Wyandotte Chemicals Corp., Wyandotte, Mich. This product is suggested for use as an adhesive, as a thickening and suspending agent, as a sizing on fabrics or as a print base. In oil well drilling muds, in paper and paint and in the processing of ceramic materials and the molding of plastics it is also said to find application.

54. Perlite Aggregate

PRODUCED by thermal expansion of an aluminum silicate containing 2-4 percent water, a hard, white, granular aggregate, light in weight and pleasing in appearance, is being made in commercial quantities by National Perlite Co., Campbell, Calif. Known as perlite, the material has excellent insulating characteristics and strength, may be classed as a non-absorbent and is fireproof and chemically inert. It can be used in concrete and plaster aggregates, pipe covering, cold storage and industrial insulation, acoustical and roof tile, plaster and insulating board, foundry sand, abrasive cleaning compounds and powdered silica for paint manufacture. One cu.ft. of expanded perlite weighs 6-8 lb. as against approximately 81 lb. for dry sand aggregate. Using Portland cement as a binder, a brick 7.5 x 3.5 x 2.5 in. will average a little over 2 lb., while the same size clay brick is over 5 lb.

Depending on individual specifications required, perlite aggregate can be processed to produce material weighing 2-20 lb. per cu.ft. There is a close relationship between weight and strength, but in general the aggregate can be made with sufficient strength to pass building codes. Grain sizes of particles can be furnished to meet 4-100 mesh requirements. Insulating characteristics are equal or superior to cork, and other known similar products. Perlite-concrete building blocks, all sizes, solid and hollow, are laid in the same manner as standard blocks. Such blocks are only one-third the weight of standard concrete blocks and

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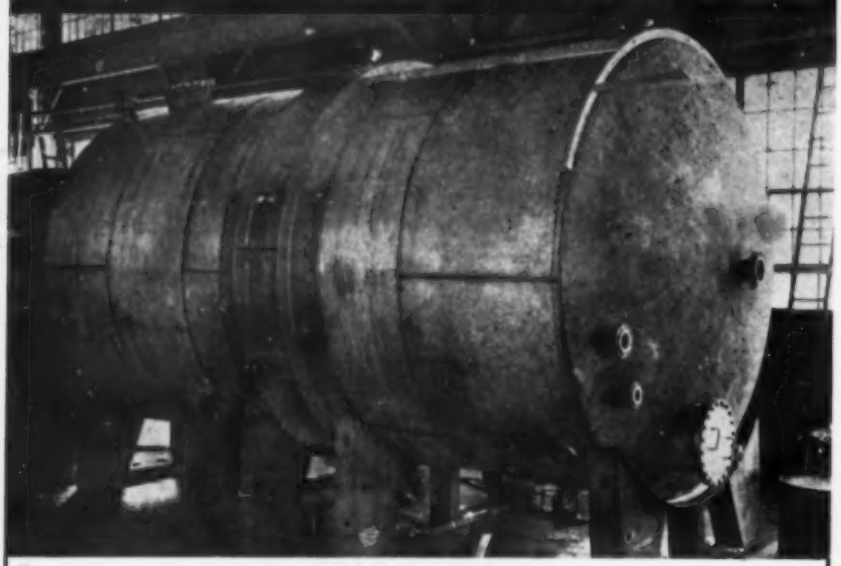
STAINLESS VESSEL



LEADER BUILDS
TANKS — KETTLES — FRACTIONATING COLUMNS
HEAT EXCHANGERS and SPECIAL EQUIPMENT
OF
STEEL—STAINLESS STEEL—NICKEL—MONEL
INCONEL—COPPER—EVERDUR—HERCULOY
HASTELLOY — ALUMINUM and CLAD STEELS

LEADER IRON WORKS, INC.
2200 N. JASPER DECATUR, ILLINOIS

REPLACE GASKETS QUICKLY...EASILY

Williams FLANGE-JACKS, formerly manufactured by T. J. Persson Co., Bloomfield, N. J., eliminate long, costly shut-downs for gasket replacements. Ease of operation permits speedy separation of flanges regardless of location.
Operating with a minimum of effort even in tight, cramped quarters, FLANGE-JACKS exert tremendous pressure evenly and smoothly...without shock along the pipe line. Bolt holes are securely held in perfect alignment and flange faces cannot be damaged.
See your distributor for trade discounts on these fully patented tools.
J. H. WILLIAMS & CO., BUFFALO 7, N. Y.

Stand. No. 20 $24.00 pr.
Giant No. 30 $48.00 pr.

SOLD IN [illegible] PAIRS

WILLIAMS Flange-Jacks

can be cast with a rough surface for plastering, or sufficiently smooth to make a presentable appearance for industrial buildings. Perlite-concrete slabs present interesting possibilities in pre-fabricated construction. Perlite plaster resists cracking and checking, weighs about one-third as much as standard sand plaster, has unusual insulating and acoustical properties, and is not affected by temperature changes and curing. In addition, it can be sawed like wood and nails can be driven with only local fractures. Processed perlite is susceptible to artificial coloring and provides a neutral painting base suitable for any color or tint. Several other western companies are making perlite aggregate in large quantities for the building industry and progress is being made in standardizing the aggregate for specific uses.

55. Synthetic Detergent

COMMERCIAL production of a new detergent has been announced by Publicker Industries, Inc., Philadelphia 2, Pa. An akyl aryl sulphonate prepared in a dry flake form, it is known as Surface Active Agent HHS. The manufacturers report that it is a good wetting, spreading, leveling and foaming agent. Stable in hard water, it will disperse calcium soap and has emulsifying properties. Since it is active in acid or alkaline solutions as well as in hard and soft water, it should find wide application in the processes used by the textile, paper and leather industries. It is suggested for use alone or with other substances to produce liquid and powdered cleansing materials for the metal, food, dairy, sanitary supply and household cleaner supply industries.

56. Bleaching Clay

RECENTLY introduced by Innis Speiden Co., 117 Liberty St., New York, N. Y., is a bleaching clay known as Adsorbol. This adsorbent clay, available in both natural and activated forms may be used to decolorize and deodorize various types of vegetable, animal and mineral oil products. Adsorbol may be employed for cleaning solvents for reuse in the dry cleaning industry and may also be used for decolorizing dirty crank case oil.

57. Chlorinated Rubber

FOR THE FIRST time in six years the Hercules Powder Co., Wilmington, Del., is again producing Parlon, its chlorinated rubber base for concrete paints and other protective coatings. A quick-drying, film-forming thermoplastic, its resistance to alkalis, acids

ur sincere good wishes
for a joyful Christmas
and a New
lishment
MEYDEN CHEM
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New York

Complete *Your* process-picture

with

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SODIUM HYDROSULPHITE

"Virginia" Sodium Hydrosulphite is a concentrated, white, stable, free-flowing, uniformly crystalline powder, readily soluble in water. Its powerful action will reduce solutions of the salts of selenium, tellurium, arsenic, antimony, bismuth, silver, gold, copper, chromium, and mercury. It is widely used in the bleaching of soaps, sugars, oils, minerals, straw, and various fibres. Shipped in 250 lb. steel drums.

Perhaps "Virginia" $Na_2S_2O_4$ can perform some important function in improving your processes. Let us help you in adapting it . . . there's no obligation. VIRGINIA SMELTING COMPANY, West Norfolk, Virginia.

Established 1898

VIRGINIA *Chemicals*

SULFUR DIOXIDE
SODIUM HYDROSULPHITE • ZINC HYDROSULPHITE
ZINC SULFATE

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and other corrosive chemicals makes it suitable for use in maintenance paint for protection of both concrete and metal finishes. Used to fortify long oil alkyd enamels, it is said to reduce the time of bake, speed air dry time and improve the chemical resistance of the enamel. According to the manufacturer, flameproof cloth coatings, adhesives, specialty inks and paper coatings for food packaging are all improved by Parlon. Parlon X, chlorinated synthetic rubber, which was manufactured during the shortage of natural rubber, will no longer be produced.

58. Resin Latex

DEVELOPMENT of a new latex which increases the stiffness, hardness and tear strength of both natural and synthetic rubbers has been announced by the Goodyear Tire and Rubber Co., Akron, Ohio. Called Pliolite latex 190 the new material is said to reinforce the rubber stocks used in such articles as molded toys and sports equipment, fabric coatings, dipped goods and paper impregnates. It is a highly stable water dispersion of a high styrene-low butadiene copolymer resin. An investigation has been made by the company to determine the effect of incorporating Pliolite latex 100 in natural rubber latex, neoprene latex type 571, GR-S type III latex and a buna N latex. Each was compounded with typical curing ingredients and then Pliolite latex was added in the ratio of 0, 10, 15, and 20 parts to each 100 parts of the latex. Films were prepared from the compounded latices and the physical properties of the films were determined. According to the company, the stiffness, tear strength and hardness of all of them was improved. Furthermore the other properties of the natural and synthetic rubbers were not appreciably affected. The light color and low specific gravity enable it to be used where darker and heavier reinforcing agents cannot be used.

59. Insecticides

A NEW class of insecticides which are non-poisonous to men and animals has been announced by the Mellon Institute, Pittsburgh, Pa., and Dodge & Olcott, Inc., New York. The new synthetic materials include piperonyl cyclonene and numerous related compounds. Piperonyl cylonene, the only one available commercially, is a mixture of chemical substances. The most important of them is hexyl-5-(3,4 methylenedioxyphenyl)-3-carbethoxy-2-cyclohexen-5-one. Stability, lack of odor and taste, solubility in most organic solvents and only slight solubility in hydrocarbon oils are some characteristics of the piperonyl com-

QUICK AS A FLASH!

LIMITAMP CONTROL

GIVES SURE, SHORT-CIRCUIT PROTECTION

In less than *one-quarter* cycle, EJ-2 fuses in Limitamp control can cut off a rise in current from a short, and clear it in one-half cycle—long before the short has time to harm the contactor or motor. Your plant's power system needs this prompt handling of fault currents, and you will avoid the risk of costly shutdowns that can result from one, mad short circuit.

A STARTER AND PROTECTOR IN ONE CABINET

G-E Limitamp control consists of an airbreak contactor (the motor starter), and EJ-2 fuses (the short-circuit device). They are mounted in separate compartments of one, all-steel cabinet.

Airbreak contactors are specially designed for hard duty. Operating experience has proved they furnish reliable, low-cost service with only routine maintenance.

Because they operate in air, they eliminate the problem of handling oil. And tip life of airbreak contactors is many times that of comparable oil-immersed tips.

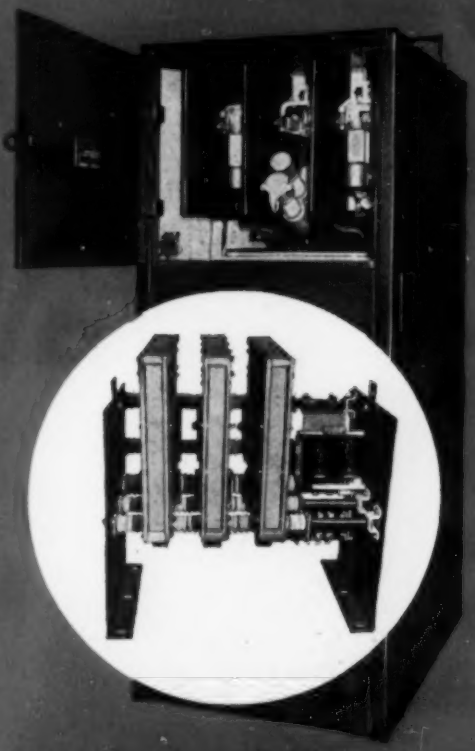
You can depend on EJ-2 fuses for sure, short-circuit protection. They are "fail-safe" devices. There is nothing about them to wear. They are easy to replace.

OVERLOAD AND UNDERVOLTAGE PROTECTION

Isothermic overload relays, accurately calibrated against actual motor characteristics, guard the motor against overheating from sustained loads or single phasing.

FACTORY-ASSEMBLED CONTROL

Factory-assembled in one cabinet, Limitamp is easy to install, easy to co-ordinate with other control, saves space, and improves the appearance of your plant.



Limitamp control is furnished as a single unit, in groups, or in special enclosures for special operating conditions.

The Trend is to AIR

G-E LIMITAMP . . . THE FIRST HIGH-VOLTAGE CONTROLLER WITH AIRBREAK CONTACTORS

GENERAL ELECTRIC

Apparatus Department,
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Schenectady 5, New York

Please send me Bulletin GEA-4247 on Limitamp control.

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Company.....

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PROTECTIVE APRON
Designed by YOU to Help your Safety Program

PERMANENTLY FUSED EYELETS WITH STRONG TIE-CORDS

NO CLOTH STITCHING REINFORCED STRESS POINTS

SPECIALLY CONSTRUCTED TROUGH CATCHES DRIPPINGS

During a recent on-the-spot field survey, West talked with hundreds of industrial workers and safety engineers to determine what features they would like to see incorporated in a protective apron. The new Durma-Gard is the result—your own idea!

Durma-Gard is a *completely new* protective apron that provides *maximum safety* against acids, alkalis, grease and oils, and effectively resists absorption, dust, powders and other occupational hazards. Yet it weighs no more than 10 ounces, thereby permitting full freedom of movement and unhampered efficiency.

The Durma-Gard Apron also provides a specially constructed "trough" which catches "drippings", thereby protecting legs and shoes. Made of clear, transparent "Vinylite", Durma-Gard washes readily with soap and water. Full cut, standard size.

Throughout the United States and Canada are close to 500 trained West Safety Consultants. To learn more about Durma-Gard, simply call the West representative nearest you.

WEST Company

Products That Promote Sanitation

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★ BRANCHES IN PRINCIPAL CITIES OF THE UNITED STATES AND CANADA

CLEANSING DISINFECTANTS • INSECTICIDES • ROTER VENDING MACHINES
PAPER TOWELS • AUTOMATIC DEODORIZING APPLIANCES • LIQUID SOAPS

pounds. Even in massive doses they are non-irritating and non-toxic to warm-blooded animals. The lack of toxicity applies not only to oral administration but to inhalation, skin absorption, sensitization etc. Formerly, pyrethrum and to a somewhat lesser extent rotenone, both of botanical origin, were practically the only insecticide materials regarded as safe for unrestricted use.

60. Streptomycin Nutrient

A NEW soybean nutrient for streptomycin-producing mold has been developed by the A. E. Staley Manufacturing Co., Decatur, Ill. It is said to give a greater yield at lower material costs and replaces the more complex growth-producing substances formerly used. The soybean nutrient costs the producers about 1/10 as much as the protein materials now being used. The manufacturer hopes that the yield of streptomycin will be increased by the use of its product.

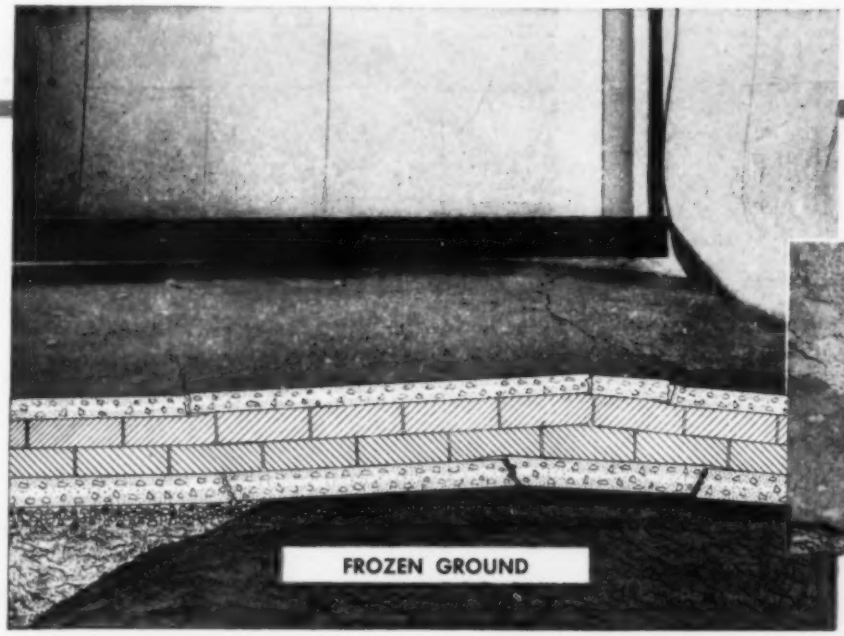
61. Setting Agent

AVAILABILITY of a crystalline condensation product resulting from the reaction of one mol of ethylene diamine and two mols of formaldehyde has been announced by Rhodes Industrial Corp., East Hampton, N. Y. The compound, identified as EDF crystals, has been found to be reactive when used as a setting agent in phenolic-type thermosetting resins. New types of resins are produced when the condensation is effected between the EDF and the phenol directly. EDF has also indicated value as an accelerator in the vulcanizing of rubber, as a "vulcanizing agent" in polyvinyl resin compounds, as a crosslinking agent in protein fiber chemistry, and generally as a new chemical intermediate. Research size samples are available.

62. Emulsion Cement

THE ABILITY to permanently adhere ungummed paper labels to a variety of surfaces and surface finishes characterizes a new cement made by Paisley Products, Inc., Chicago, Ill. Designated as No. 1707, this resin-latex emulsion cement is being offered for fastening instruction labels, circuit diagrams, caution and brand labels to electrolytic tin plate etc. It is also suitable for many combining and laminating operations on similar and dissimilar materials, such as cork to metal, felt to cardboard, paper to glass and ceramics. Tests made by the company indicate that good adherence is maintained by this product under extremes of temperature and humidity. Furthermore, no odors or discoloration

How to prevent frost damage to on-grade freezer floors



FROST IS POWERFUL. It can lift a floor and wreck a building. Under an on-grade floor, frost pressure builds up near the center of the room. It causes cracking and bulging of the floor and buckling of the walls.

THIS STOPS FROST DAMAGE. Drain tile laid under the subfloor permits outside air to warm the subsoil and stop frost formation.

WHEN a large freezer room is built directly on the ground, there's real danger that the soil beneath it will eventually freeze. As the frost builds up, it exerts sufficient force to heave up the cold room floor, bulge the walls, and overtax the capacity of the refrigerating system.

Frost formation occurs over years of operation. Ground heat is drawn out of the earth and through the floor faster than it can be replaced by outside heat flow into the ground at the edges of the building. The length of time required for formation of a damaging amount of frost will depend upon soil conditions, quality of insulation, and general construction. However, no practical amount of insulation can prevent flow of heat from the subsoil through the floor and consequent lowering of earth temperature. Insulation retards rather than prevents heat passage.

To forestall frost damage, Armstrong engineers have worked out economical methods of ventilating the soil under freezer rooms built on-grade. Air ducts, either of concrete or drain tile, are spaced at regular intervals in a cinder or crushed stone fill under the subfloor. These ducts introduce sufficient warm air to keep ground temperatures above the freezing point and prevent formation of frost.

Before you build any refrigerated space, it pays to talk your plans over with one of Armstrong's engineers. There's no obligation. Drawing on Armstrong's vast experience, the engineer can often make suggestions that will prevent needless dissatisfaction and expense. For complete details, write to Armstrong Cork Co., Building Materials Div., 3312 Concord St., Lancaster, Pa.

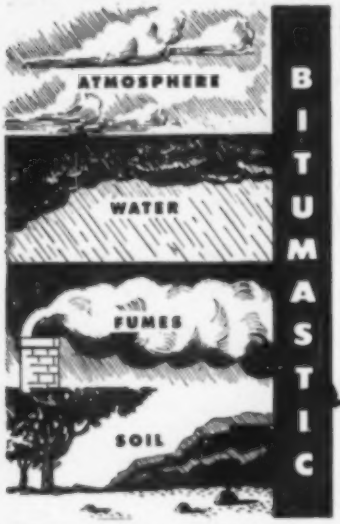
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service
For All Temperatures

From 300° below zero

To 2800° Fahrenheit

SIX BITUMASTICS . . . FOR STUBBORN DEFENSE AGAINST CORROSION AND RUST



BITUMASTIC* BLACK SOLUTION

BITUMASTIC SUPER-SERVICE BLACK

BITUMASTIC TANK SOLUTION

BITUMASTIC HI-HEAT GRAY

BITUMASTIC "50"

BITUPLASTIC*

THEY ARE TOUGH — Bitumastic protective coatings are tough! Their base of carefully refined coal tar pitch is a natural seal against corrosion. Each of the six products listed above has its specific application in the continuing battle against rust and corrosion.

AND THICK! The coatings are thick. Bitumastic #50 for example covers with a thickness of 1/64" to the coat—about 5 times the thickness of paint. Successive applications can provide a seamless, non-porous sheath up to 1/16" in thickness. Coatings are applied cold with either a brush or spray gun.

When you have surfaces of metal, masonry or concrete exposed to corrosive conditions, seal them against premature deterioration with one of the six Koppers Protective Coatings.

BE SURE TO SPECIFY GENUINE BITUMASTIC

Suggestions for the correct use of Bitumastics and Bituplastic are given in our folder "Corrosion." Ask for your copy.

KOPPERS COMPANY, INC.
Wailes Dove-Hermiston Department • Westfield, N. J.
*REG. U. S. PAT. OFF.

KOPPERS PROTECTIVE COATINGS K KOPPERS

RATINGS THAT ASSURE TABER PUMP PERFORMANCE

In the processing industries, Taber "general use" Centrifugal Pumps prove superior to trade pumps.

Features which indicate their extreme flexibility and dependability, are a variety of impeller combinations for given-size casings; casings of various sizes for given-size yokes; over-size ball bearings; extra size shafts; extra deep stuffing boxes—all assembled and conservatively rated for the final requirements of *your* job.

FOR COMPLETE INFORMATION, PLEASE WRITE ON YOUR LETTERHEAD FOR TABER **SPECIAL BULLETIN CL-339** 5428

TABER PUMP COMPANY
ESTABLISHED 1859
294 ELM STREET
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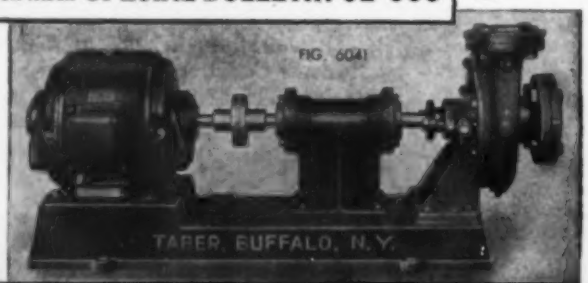

TABER PUMPS for Higher Practical Performance

of the surface are noticeable. The adhesive can be reduced with water or used as received. It is applied by hand brushing or with table model gumming machines. According to the makers, the adhesive does not foam or build up on the rollers even under extended running periods. It is available in commercial quantities ranging from 1 gal. to 55 gal. drums.

63. Liquid Plastic

NEITHER heat nor pressure is needed to cure the new phenolic resin coating material made by the Lockrey Plastic Products Co., Flushing, N. Y. Applied to almost any type of surface with brush or spray, Phenoplast sets or polymerizes to form a plastic coating. This finish can be used on floors, furniture, on the hull, deck or superstructure of boats. It may be applied to perfume bottles and caps made of other plastics so that they will resist the action of perfume oils and solvents.

Layers of impregnated fabric may be formed into experimental plastic auto bodies, etc. Other probable uses of the plastic include coating mineral and zoological specimens for preservation, coating plywood to make waterproof stall-showers, sign-lettering on tank-trucks to resist the action of solvents carried or used for cleansing, putting a finish on violins and guitars and insulating all but the tips of electrical instruments.

64. Metal Cleaners

THREE classes of Parco Cleaners for steel, zinc and aluminum have announced by the Parker Rust Proof Co., Detroit, Mich. They include emulsion types, acid types and alkaline types. Tested in the laboratories of the manufacturers, the cleaners are said to meet varying specifications and conditions. They are claimed to make hard water suitable for cleaning, to remove soil from metal surfaces, to condition them for fine, dense, Bonderite coatings, to remove rust and grease prior to painting and to provide easier control.

65. Photographic Papers

SILVER-SENSITIZED paper for reproducing engineering drawings on blueprint or direct-process equipment has been developed by the Eastman Kodak Co., Rochester, N. Y. Known as Kodagraph Autopositive, the paper embodies an emulsion which permits its use in normal room light and produces a high-contrast positive copy directly from a positive original. According to the maker, it is exposed on blueprint or direct-process equipment or other equipment having a high intensity light source. Either the "print-

When it comes to better, faster, lower cost mixing of thermoplastic powders, you can't beat the Simpson method of *controlled* "mulling," to provide the desired impregnation of plasticizers and fillers into the resins.

Simpson Mixers are available in sizes to handle batches from 1/5th to 50 cu. ft., and may be steam or water jacketed to provide heat for more rapid blending of plasticizers. All models are virtually self-cleaning, and offer the well-known automatic discharge feature.

Write for further details about Simpson Mixers now in use on scores of difficult mixing jobs on dry, semi-dry and plastic materials. National Engineering Service is yours for the asking.

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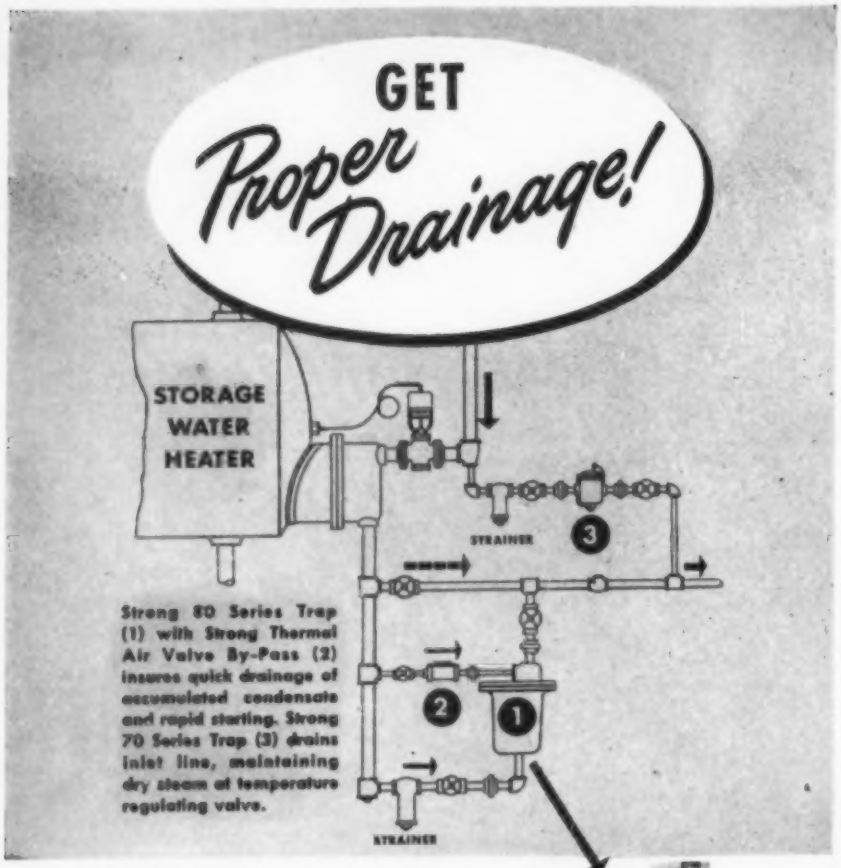
Manufacturers and Selling Agents for Continental European Countries — The George Fischer Steel & Iron Works, Schaffhausen, Switzerland. For the British Possessions, Excluding Canada and Australia — August's Limited, Halifax, England. For Canada — Dominion Engineering Co., Ltd., Montreal, Canada. For Australia and New Zealand — Gibson, Battle & Co., Pty., Ltd., Sydney, Australia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Proper Drainage!
STORAGE WATER HEATER
STRAINER
STRAINER
3
2
1
Strong 80 Series Trap (1) with Strong Thermal Air Valve By-Pass (2) insures quick drainage of accumulated condensate and rapid starting. Strong 70 Series Trap (3) drains inlet line, maintaining dry steam at temperature regulating valve.

PROBLEM: Condensate accumulates in coils due to lack of pressure when thermostatic regulating valve is throttling or closed. *Improper drainage and water hammer result when thermostatic valve opens.*

SOLUTION: *Drain coils fast.* Use trap with four to eight times capacity of actual steam condensate rate. For medium or high pressures, either open or inverted bucket traps are suitable. *Use open bucket traps for low pressures.*

Completeness of the Strong trap line enables our engineers to recommend exactly the type or size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc., forged, welded, cast or semi-steel construction. Bring your drainage problems to us for solution. Send for Strong Trap Catalog No. 67 today for complete details of *all* Strong traps.

Strong 80 Series Trap for medium or high pressures.

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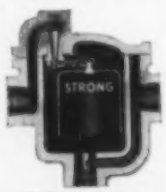
Reducing Valve



70 Series Trap

Strainer

STRONG

FOR MORE INFORMATION
See Reader Service Coupon on pages 173-174

through" or the "reflex" method of printing may be used. Exposure time of this paper is comparable to that of other materials commonly used in the drafting room. After printing, the paper is processed according to conventional photographic practice, but in normal room light. Supplied in standard sheet and roll sizes, Kodagraph Autopositive was designed for use as a printing intermediate or "master." It is said to facilitate the production of blueprints or diazos.

66. Synthetic Coating

DESIGNED to insulate and protect electroplating racks, a new synthetic coating has been announced by United Chromium, Inc., 51 East 42nd St., New York 17, N. Y. Marketed as Unichrome Coating 218, this material contains 100 percent solids. It is a baking synthetic, applied by dipping or spraying. Upon curing at 350 deg. F. it becomes an elastic coating. On some racks, it is said, thicknesses up to ¼-in. can be achieved within two hours if desired. According to the manufacturer, the coating withstands mechanical abuses without chipping, tearing or lifting. It also withstands a variety of strong chemicals in addition to hot cleaning solutions and all plating baths. Resistance to abrasion, aging, oils and corrosion make it suitable for use on dipping baskets, wire screens, mixing equipment, propellers, rotors of air-blowers, and as gaskets and linings.

67. Amino Acid

PREVIOUSLY obtainable only in limited quantities at a cost of several hundred dollars a pound, synthetic methionine is now being produced for commercial consumption. The U. S. Industrial Chemicals, Inc., 60 East 42nd St., New York, N. Y., has now put into effect a new low-cost method of manufacture. Promising results in the treatment of liver damage have been achieved with methionine. Small additions of it to vegetable protein increases biological efficiency and allows replacement of marine or animal protein now in short supply. Both the pharmaceutical and feed manufacturing industries will benefit from this 97 percent reduction in the cost of methionine and the increased supply.

CHEMICAL ENGINEERING NEWS

Richard F. Warren, ASSISTANT EDITOR

Naval Stores Plant Starts Operation in Louisiana

ON October 31 a new $5 million solvent extraction naval stores plant was formally opened at Oakdale, La., by Newport Industries, Inc. Capacity of the plant is approximately 100 tons of rosin, 3,500 gal. of turpentine, 2,000 gal of pine oil and 500 gal of dipentene per day. Pine stumps from a wide area in Louisiana will be processed. Newport Industries is also manufacturing naval stores at Bay Minette, Ala.; Pensacola, Fla.; and De Quincy, La.

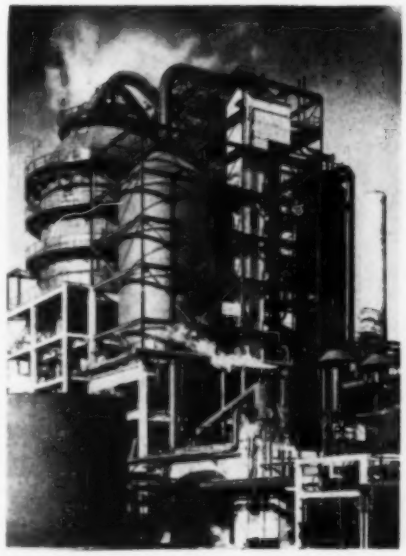
An official of the company says the new Oakdale plant embodies a number of process improvements which were made on the basis of experience at the company's other extraction plants. Continuous processing is employed wherever possible. Continuous fractionating units have replaced conventional batch stills at some points. Marked improvements have been made in the handling and preparation of the raw material. Stone & Webster Engineering Corp. designed the plant in collaboration with company engineers.

Materials Handling Session To Study Cost Reduction

COST REDUCTION in the chemical industries through improved materials handling will be the theme of discussion at the Materials Handling Conference to be held in the Public Auditorium, Cleveland, Ohio, on January 12-16. Discussions will include all phases of handling operations, from the viewpoint of the manufacturer, distributor, and retailer, and will include problems of warehousing and shipping. The conference is being held in conjunction with the National Materials Handling Exposition.

Petrochemical Unit Planned Near Corpus Christi

OPTIONS covering 215 acres of land near Corpus Christi, Tex., which will probably be used for facilities to manufacture chemicals from petroleum derivatives, were acquired in October



Two catalytic refining units, similar to this recently completed Philadelphia unit, will be built in Gulf's $20,000,000 Ohio expansion program

by Continental Oil Co. Company officials in Corpus Christi said this use of the properties is contemplated, although they said that final plans would depend upon construction costs and a further study of the market for the products which would likely be made. The options run for three years. Officials did not comment on reports that the plans contemplate a multi-million dollar plant investment.

New Research Program on Crystallization Begun

NORTHWESTERN UNIVERSITY has started a new program of fundamental research on the process of crystallization which will aid the pharmaceutical, chemical, sugar and salt industries in the search for pure materials. "Since less is known about the formations of crystals than about any other common phenomenon of industrial interest," said Dr. Garrels, assistant professor of geology, "our goal in this fundamental research is to obtain information on the control of crystal size for the chemical and related industries and the growth of large single crystals for use in the optical and electrical fields. Photographic sampling has simplified experiments and reduced time expended by 90 percent."

British Engineers Join in Detroit AIChE Meeting

HOST for the fourth time to the American Institute of Chemical Engineers, Detroit made the 40th annual meeting one of the most successful ever held by that organization. It was featured by the active participation of a group of guests from the Institution of Chemical Engineers of Great Britain, under the leadership of Major V. F. Gloag, vice president, with A. J. Prince as secretary. Included in the party were H. Talbot, E. C. R. Spooner, R. F. Fisher, E. H. T. Hoblyn, E. J. Stephens, L. A. Mitchell, T. H. Blakeley, C. W. Maplethorpe, J. F. Matthews, H. K. Collinge, S. S. Grimley, C. J. Goodwin, Ivor Wells, R. M. Deanesely, G. N. Barany, R. S. Colborne, H. Brooker and W. G. Hiscock.

Registration reached approximately 1,500, not including representatives from more than 20 midwestern student chapters who attended a two-day student conference. Visits to industries in the Detroit area, across the river to neighboring Canada, to Dow's at Midland, and the chemical and metallurgical engineering laboratories at the University of Michigan proved popular features of the meeting.

The technical program included eight sessions with special symposiums on Fisher-Tropsch synthesis, ion-exchange, low temperature processes, processed foods and agricultural products and materials of construction.

The annual business meeting was featured by a lively discussion of a number of constitutional amendments proposed by petition or resolution of the Institute's council. The meeting went on record opposing all except a liberalization of membership requirements to admit "recognized leaders in chemical engineering education." These proposals now go to the membership for final vote. Newly elected directors include: M. C. Molstad, John

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J. Healy, Jr., William T. Nichols and William I. Burt. S. L. Tyler and C. R. DeLong were re-elected, secretary and treasurer, respectively.

C. E. K. Mees, vice president in charge of research, Eastman Kodak Co., addressed the annual banquet on "Scientists Must Accept Social Responsibilities"—an eloquent plea for the application of the scientific method in a field too long dominated by emotional and political appeals. The Institute's retiring president, Charles M. A. Stine presented the William H. Walker Award to Manson Benedict of Hydrocarbon Research and Lewis C. Rubin of M. W. Kellogg Co. and the Junior Awards to Harry G. Drickamer of the University of Illinois and Harry H. Hummel of the University of Wisconsin. The A. McLaren White Award in the student problem contest went to W. J. Terrell of Gulf Oil Co., with second prize to E. F. Machell of the University of British Columbia and third prize to M. E. Brooks of Cooper Union. Professor E. W. Comings, chairman of the Stu-

CONVENTION CALENDAR

Chemical Market Research Association, winter meeting, Mayflower Hotel, Washington, January 22.

American Standards Association, Seminar on Standardization, Engineering Societies Bldg., New York, January 26-30.

Association of American Soap and Glycerine Producers, Waldorf-Astoria Hotel, New York, January 28-29.

National Materials Handling Exposition, Public Auditorium, Cleveland, Ohio, January 12-16.

American Society of Heating & Ventilating Engineers, eighth international heating and ventilating exposition, Grand Central Palace, New York, N. Y., February 2-6.

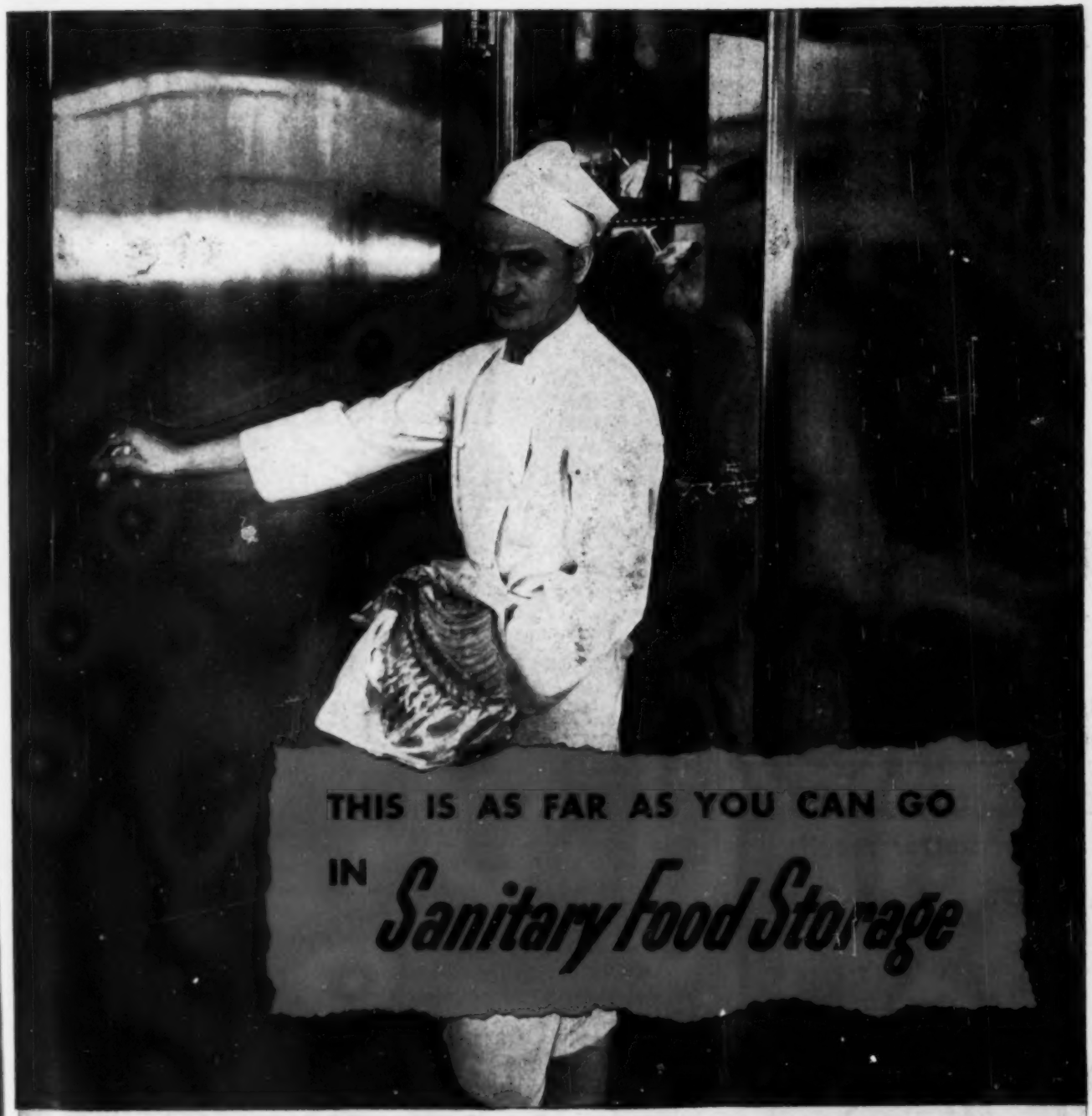
American Institute of Chemical Engineers, regional meeting, New Orleans, La., February 15-19.

Technical Association of the Pulp and Paper Industry, national meeting, Hotel Commodore, New York, N. Y., February 23-26.

National Association of Corrosion Engineers, fourth annual conference, Jefferson Hotel, St. Louis, Mo., April 5-8.

Midwest Power Conference, sponsored by Illinois Institute of Technology, Sherman Hotel, Chicago, April 7-9.

American Chemical Society, 113th national meeting, Chicago, Ill., April 19-23.



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The bright, hard surface of Allegheny Metal is extra-easy to clean and keep clean—and its remarkable corrosion resistance combines with great strength and endurance to provide a lifetime of beauty and sanitary service. If product purity and sanitation are important factors in your business—whether or not it has anything to do with food—you owe it to yourself to learn more about Allegheny Metal . . . its ease of fabrication . . . its long-term economy. ● Let our technicians show you just how far you *can* go in getting better service from equipment by making it of Allegheny Metal. It's available *now*—call for an Allegheny Ludlum Engineer.

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A Portable
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Built with the ENGELHARD frictionless galvanometer, eliminating bearings and pivots.

Strongly built to stand rough service. Nine standard scales—4 Centigrade, 5 Fahrenheit. Special scales available. Weight 11½ lbs.

Write for descriptive Bulletin 400

Charles Engelhard, Inc.

900 Passaic Ave. East, NEWARK, N. J.

Watching a step in preparing high temperature inorganic insulating material are some of the delegates to General Electric Co.'s recent three-day Chemical Department Conference. It was designed to promote better understanding between educational institutions and industry and was attended by representatives of 30 colleges and universities. Among highlights of the meeting were tours through the research laboratory of the chemical department in Schenectady, chemical department plant in Pittsfield, and the silicone plant at Waterford, N. Y. Left to right are: Prof. C. F. Bonilla, Johns Hopkins; Prof. L. S. Coonley, R. P. I.; Prof. P. J. W. Debye, Cornell; A. H. Emery, secretary of the ACS; Prof. S. B. Wiltse, R. P. I.; and Fred Hartwell of the Pittsfield Laboratories, chemical section

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dent Chapters Committee, also presented honorable mentions to D. W. Peaceman of the College of the City of New York, J. W. Blanton of the University of Oklahoma, and C. R. Thomas of A. & M. College of Texas. Dr. Mott Souders of Shell Development Co. was chairman of the committee that prepared the problems and supervised the contest.

Professor Alfred H. White, as honorary chairman, responded gracefully to the toast presented by the general chairman and toastmaster, Harvey M. Merker of Parke-Davis. George Calingaert was toastmaster and Harold G. Donnelly, secretary of the local committee on arrangements.

Aluminum Production Resumed At Tacoma Plant

LAST of the Northwest's five aluminum reduction units was put into peacetime operations this month with the opening of one pot line at the Tacoma, Wash., plant purchased early this year by Permanente Metals Corp., Oakland, Calif. Use of the second pot line will follow shortly. Yearly output at capacity production will be nearly 21,000 tons. This, together with the Mead, Wash., plant, brings Permanente's total yearly virgin aluminum capacity to 129,000 tons—enough to supply the Trentwood, Wash., rolling mill with its approximate normal requirements.

Glycol-Amine Process Used To Sweeten Natural Gas

SOUR NATURAL gas piped to southern California from the Texas-New Mexico fields will be treated by the recently-developed glycol-amine process to meet California requirements of 0.25 grains maximum H_2S per 100 SCF of gas, simultaneously being dehydrated to prevent hydrate formation. So announces W. F. Chapin, principal process engineer of the Fluor Corp., Ltd., Los Angeles, which developed the process. The method, becoming increasingly important for removal of acid gases only, is believed to be the first that can guarantee feasible removal of H_2S so that residue gas is sweet to the Bureau of Standard's lead acetate test.

Sour gas is introduced at the bottom of the absorbing tower or contactor and passes up through the bubble trays in intimate contact with glycol-amine solution. Residue gas, free of CO_2 and H_2S and dehydrated if desired, leaves the top of the column. The rich glycol-amine solution passes through

ILLUSTRATES and DESCRIBES EQUIPMENT for:

(1) Size Reduction
(2) Materials Handling
(3) Mixing and Blending
(4) Size Classification

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City ..... *State* .....

conventional heat exchangers, where heat is exchanged with the hot lean solution, and is fed into the regenerating column or still for stripping. Solution leaving the bottom tray goes to a reboiler to provide stripping vapor, while the overhead steam and acid gas stream from the still passes through a water vapor condenser. Acid gases leave at the top; condensate is pumped to the still as reflux. Regenerated lean glycol-amine solution leaves the bottom of the still and is pumped through heat exchangers and coolers back to the contactor.

With the combination monoethanolamine glycol process, stripping of acid gas can be accomplished to a much higher degree than with aqueous monoethanolamine. Addition of glycol raises the boiling point of the solution without necessitating an increase in pressure on the regenerating column so that both CO_2 and H_2S may be stripped completely from the solution. The fact that glycol-amine solutions can be stripped so readily, particularly of H_2S, is one of the major advantages of the new process, which also shows less cooling water, steam and power requirements.

Although the glycol-amine process was developed for simultaneous acid gas removal and dehydration, its use is not thus restricted. If no dehydration is needed, the glycol-water ratio of the solution may be adjusted to give any desired residue gas purity from 0.60-0.01 grains H_2S per 100 SCF. Partial dehydration of gas is obtained with any glycol content normally employed. If more complete dehydration is required, the water content of the solution is decreased. Typical solutions in the glycol-amine process range from 10-30 percent monoethanolamine, 45-85 percent diethylene glycol and 5-25 percent water.

Louisiana Plants Plan to Expand Tung Oil Output

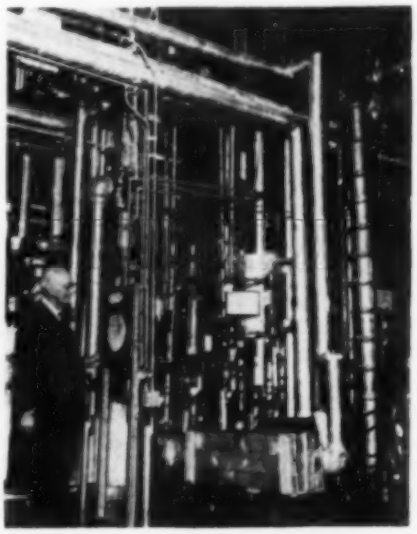
EXPANSION of capacity for the extraction of tung oil is under way in Louisiana, where production was valued at $1,379,000 last year. At Bogalusa the Bogalusa Tung Oil Co. is spending over $30,000 in the construction of a storage building for nuts and a concrete dumping bin. The new facilities are expected to increase the company's storage capacity by six times.

Also at Bogalusa the former site of the Mengel Lumber Mill has been purchased by a new company for the construction of an $80,000 tung crushing plant, paint factory and fertilizer plant.

At Covington the Ozone Tung Oil Cooperative has a $25,000 plant expansion program which will include a storage building for nuts and a number of processing tanks.

Houston Plant Will Use New Process For Acetylene

HOUSTON OXYGEN CO. expects to put into operation in the spring of 1948 at Houston, Tex., the first commercial installation in the world to utilize the electrical "glow" discharge process for the manufacture of acetylene from natural gas. The process is that developed at the University of Texas by Dr. Eugene Paul Schoch and his associates. The Houston plant, costing approximately $300,000, is scheduled to have a capacity of 2 million cu.ft. of acetylene per month.

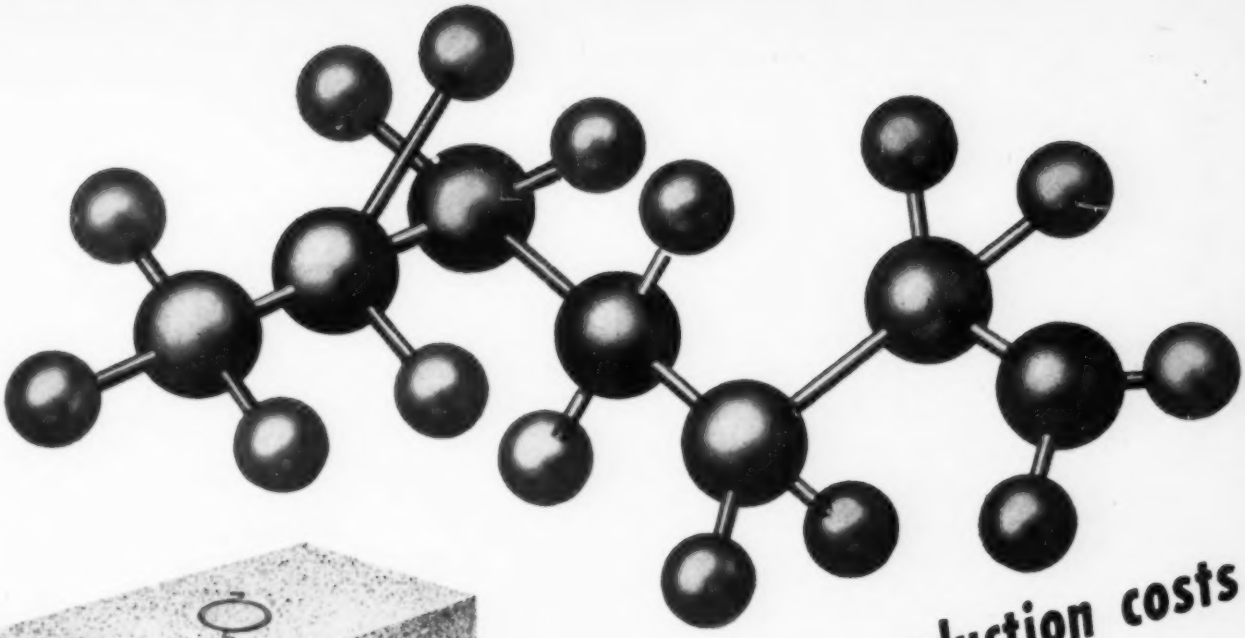


Dr. Schoch and pilot plant

This project is the culmination of 18 years of research at the University of Texas. At the end of October Dr. Schoch disclosed that in the course of the pilot plant work the mechanism of the electric arc has been thoroughly studied and that the understanding has "profound significance" for other fields of chemical manufacture in addition to acetylene production. The pilot plant operations at the university will be directed to the development of commercial processes for the manufacture of other chemicals involving the use of the "glow" discharge.

To date, slightly over $300,000 has been spent on development of the acetylene manufacturing process. Dr. Schoch considers that what has now been learned will materially reduce the time cost required to apply the glow discharge principle to the commercial production of other chemicals.

On the basis of the pilot plant work on acetylene some interesting figures



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on costs expected in commercial operation have been presented. It is considered that acetylene can be manufactured by the new process at a cost of 4.0 to 4.5 cents per lb., which is less than that of acetylene produced conventionally from carbide. This cost figure covers all items including interest and other fixed charges. The cost is about 80 percent of the cost of making acetylene by the German arc method, although the plant investment is approximately the same as that for a plant utilizing the German method. Plant investment, on the basis of 1946 costs, for the new process is regarded as $113 to $123 per kw. of power rating.

Pilot Plant Capacity

The pilot plant from which the foregoing figures were derived is of the continuous type and has a production capacity of about 15 lb. of acetylene per hr. The maximum natural gas charge rate is 1,500 cu.ft. per hr. The maximum power rate is 75 kw.

Because of pending patent claims only a few general facts concerning the process have been divulged. However, these are sufficient to indicate the nature of the plant. The plant consists of three basic sections: the electrical control equipment, the reaction chamber, and the concentrating equipment. All the electrical equipment is standard. Alternating current may be employed and has advantages over the use of direct current in this work.

Reaction Chamber

In the reaction chamber are the two rotating electrodes between which the discharge occurs under atmospheric pressure. Temperature in the chamber averages 300 deg. F. The natural gas entering the chamber is subjected to considerable turbulence, the products of the reaction emerging as a mixture of acetylene, hydrogen, unreacted methane and carbon black. To dissipate the slight excess heat, a part of the hot gases is removed from the chamber, passed through a heat exchanger and returned into the chamber. The major portion of the gases is passed through filters where the carbon black is removed. Composition of production gases before separation occurs is about 10 percent acetylene, 40 percent hydrogen and 50 percent methane and other hydrocarbons, the percentages being on the volume basis.

The product gas mixture is compressed and then passed through an oil wash unit for the removal of small amounts of certain hydrocarbons, after which the mixture is moved to a solvent extraction unit where the acetylene is dissolved in the solvent and hydrogen and methane are removed as a gas mixture suitable for industrial use or fuel. Output of hydrogen and methane is such that its heating value would be sufficient to generate all the electric power used in the process. The final acetylene product has a purity of 99 percent, and as such is suitable either for chemical processing or for welding.

Victor Chemical Builds New Florida Phosphorous Plant

VICTOR CHEMICAL CO. is constructing at a cost of over $2 million an electric furnace plant for the manufacture of phosphorus at Victor, Fla., north of Tarpon Springs, on a 100-acre site near phosphate rock deposits which will be used. Capacity of the plant has not been disclosed.

Stone and Webster Engineering Corp. is in charge of construction. Victor's engineering department designed the plant, which is scheduled to be completed late this year. A contract has been signed with the Florida Power Corp. for electric power.

Sulphuric Plant Under Construction On Oahu

CONSTRUCTION work on a new contact sulphuric acid plant has been announced by Pacific Chemical & Fertilizer Co., Honolulu, T. H. Capacity will be 25 tons of 100 percent acid daily, almost a 40 percent increase over the present chamber unit, which will be kept in standby condition. The $250,000 project is scheduled for completion by next April. Design work was done by Chemical Construction Corp.

Plan Iowa Sulphuric Acid Unit

SURPLUS equipment purchased from WAA will be moved from Minneapolis to Dubuque by the Algonquin Chemical Co. where a new $1 million sulphuric acid plant will be erected for the company by Equipment Maintenance Co., Minneapolis.

International Minerals Will Expand Fertilizer Output

THE International Minerals and Chemical Corp. plans soon to begin construction of a $100,000 mixed fertilizer plant at Somerset, Ky. The company is also installing facilities to handle phosphate rock at Bartow, Fla.

The mixing plant, the thirty-second fertilizer unit to be operated by the

Three 3-Light *Visularms* Mounted in a Horizontal Row with Back Feed Conduit Arrangement. Rear View of Panel One Cover Removed.

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safeguard continuous production
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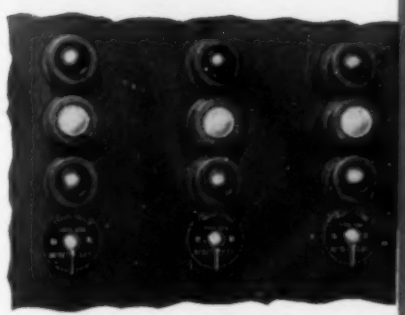
8. **Two-light and three-light** *Visularms* are available; any number can be mounted in either vertical or horizontal rows on a control panel.

Listed on new Pages 12L through 12P, Section 85, Condulet Catalog 2500.



Front View of the Panel Illustrated Above with Three 3-Light *Visularms* Mounted in a Horizontal Row.

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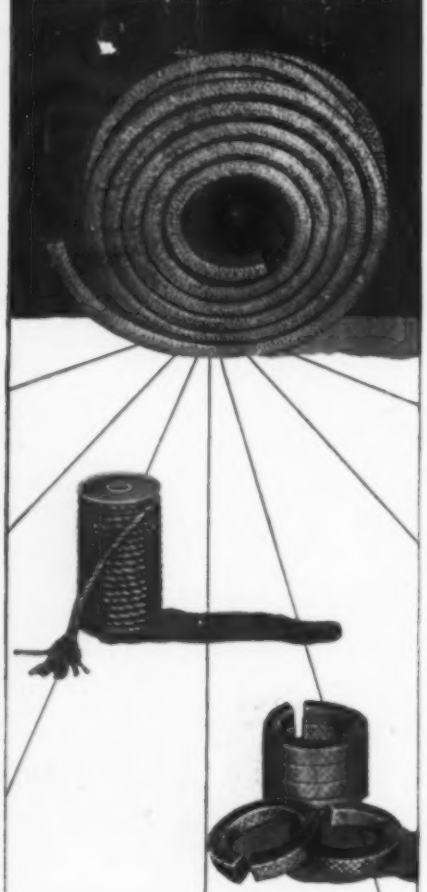

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company, is designed to produce about 15,000 tons per yr. of mixed fertilizers and is expected to be completed by spring. Potash will be brought from the company's mine at Carlsbad, N. M., and phosphate rock will be taken from the company's properties near Bartow, Fla. The company's engineering department will handle design and plant construction.

International is adding dryer facilities near Bartow. The new construction, which should be in operation in about a year, will be able to handle approximately a million tons of phosphate ore annually—the entire output of the company's mine. The mine will begin production of rock in February, but its output will be dried at other company facilities until the new equipment is installed. Rust Engineering Co. of Pittsburgh is in charge of design and construction of the dryer equipment.

Diatomaceous Earth Plant Completed in Nevada

TAILOR-MADE grades of diatomaceous earth will be produced at Clark, Nev., according to T. C. Carter, vice president, Eagle-Picher Co. The company has completed a new plant to process the material for use as a filter aid, a carrier for fertilizers and insecticides, and a filler to provide low weight bulk and strength for plastics, paints, polishes and paper. The product may also be used in high temperature insulation.

Pacific Chemical Exposition Proves Successful

THE FIRST Pacific Chemical Exposition and Pacific Industrial Conferences, held in San Francisco's Civic Auditorium during October 21-25, have proved successful. Total gate count was 14,726 and registration was 8,150. Because of leakages in the registration system, these figures are estimated to be low by about 10-15 percent. Some 35 states and territories and 20 other countries were represented. Representation from outside the West was excellent. Caliber of the attendance was unusually fine, according to most observers. The quality of the technical and survey papers presented at the Industrial Conferences was high, and a number of these were outstanding. Much new market data on the West were presented. Nine technical societies cooperated with the California section of the American Chemical Society in sponsoring and participating in the Conferences.

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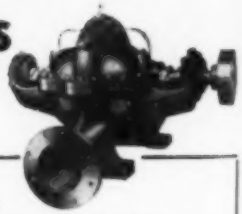

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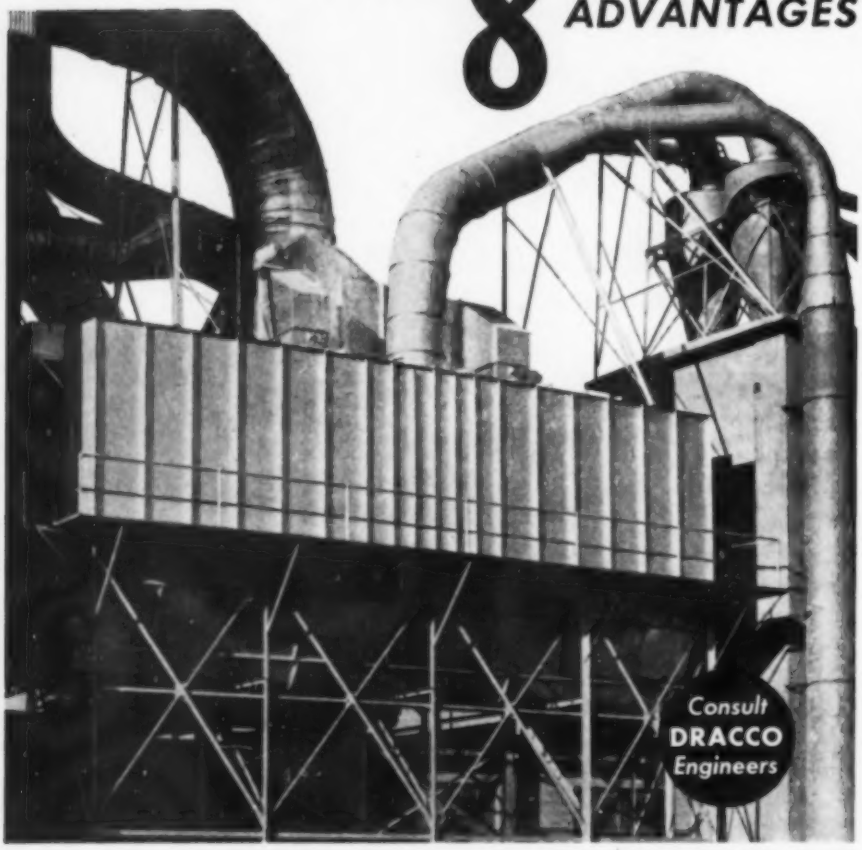

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ferences are scheduled for the San Francisco Civic Auditorium during November 1-5, 1949. Particular attention will be given to increasing attendance from foreign countries as well as increasing that from the states.

Industry Briefs

Ethyl Corp., says an official of the company at Baton Rouge, La., has become the largest producer of salt cake in the South. The product, consumed in large quantities by seven mills in Louisiana manufacturing Kraft paper, is produced in the course of manufacture of ethyl chloride.

Nation-wide survey of organized training practices followed by the petroleum refining industry, including the training of plant executives, chemical engineers and chemists, has been started by the Industrial and Business Extension Training Bureau of the University of Texas Division of Extension. This is a research project of American Petroleum Institute.

Expanding its interests in the chemical industry, the Borden Co. has purchased Durite Plastics, Inc., Philadelphia. The firm will be known as the Durite Plastics Division of the Borden Co. Executive and operating personnel remain unchanged. The transaction involved an exchange of stock valued at $3 million.

Southern Alkali Corp. has begun shipments from the caustic-chlorine facilities at Lake Charles, La., which the company took over from War Assets Corporation after the magnesium plant of which the facilities are a part was relinquished by its wartime lessee, Mathieson Alkali Works.

Negotiations for a $12 million loan for new financing of International Minerals & Chemical Corp. have been completed. Prudential Insurance Co. of America made the 17 year loan at 3¼ percent as of December 1. Out of the sum $6.6 millions will be used to pay existing bank loan, $2 million will be added to the working capital and the rest will be for plant expansion.

Monsanto Chemical Co. has established a department of economic research and appointed William H. Winfield as its manager.

Kelly, Weber & Co., Lake Charles, La., expects to complete by February a dry mixing plant at Eunice, La., to manufacture between 6,000 and 8,000 tons per yr. of complete fertilizers. Superphosphate for the operation will come from the company's plant near

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Sectional Steel Headers

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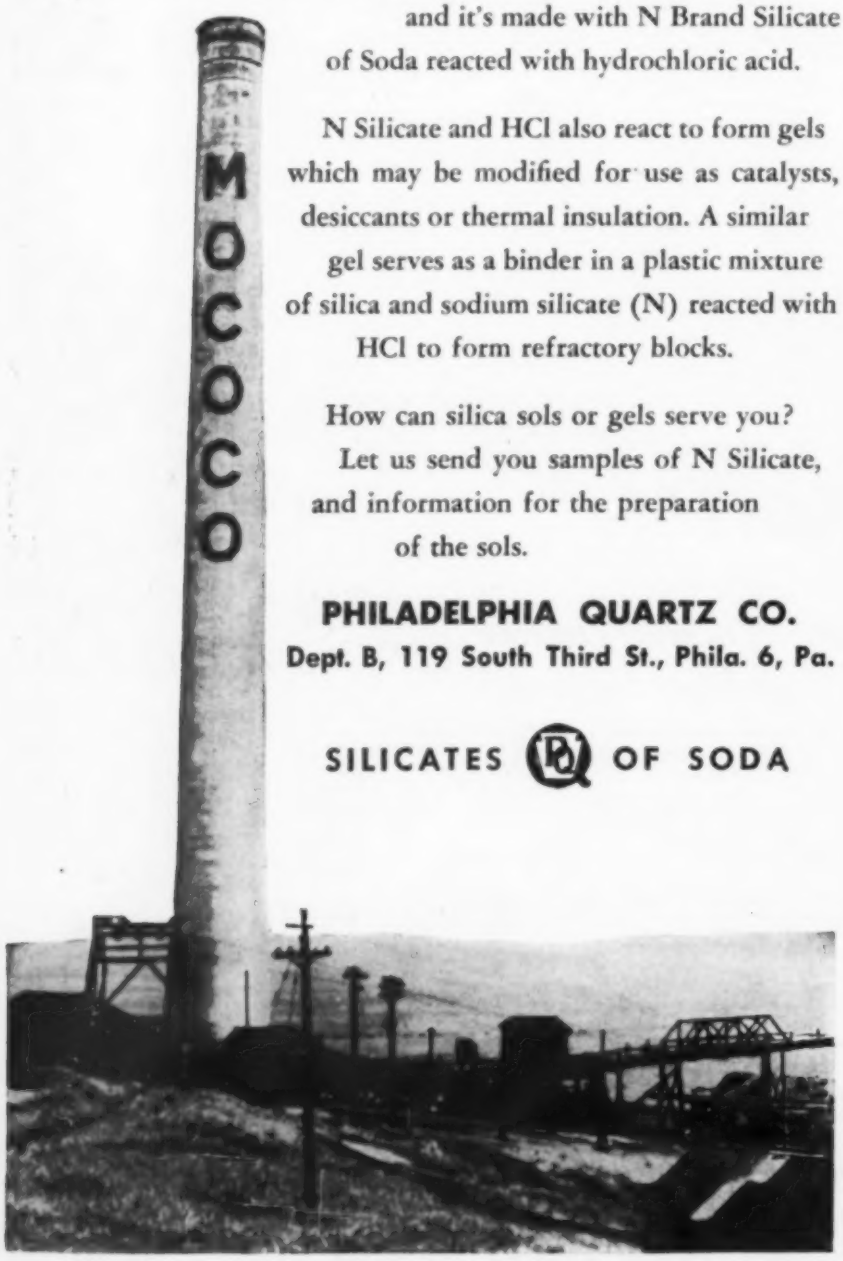

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SILICATES PQ OF SODA

Lake Charles. Cost of the dry mixing plant may approach $200,000.

Permanente Metals Corp. was high bidder for the first reparations plant offered to American industry. Henry Kaiser, president, plans to bring the dismantled aluminum-foil plant here.

A new $1 million sulphuric acid plant has been placed in operation at Little Rock, Ark., by Southern Acid & Sulphur Co. The plant has a daily capacity of 200 tons.

First international conference of the Electron Microscope Society of America was held at the Franklin Institute in Philadelphia, December 11-13.

Indexes

CONTINUING the practice started by *Chem. & Met.* several years ago, printed below are indexes for Reports and Pictured Flowsheets published to date.

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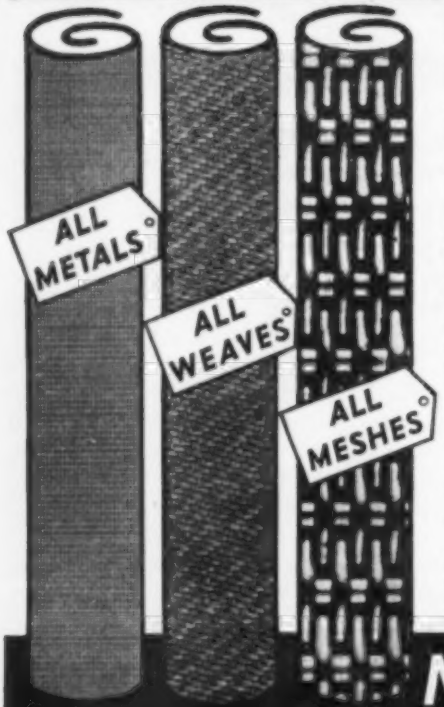

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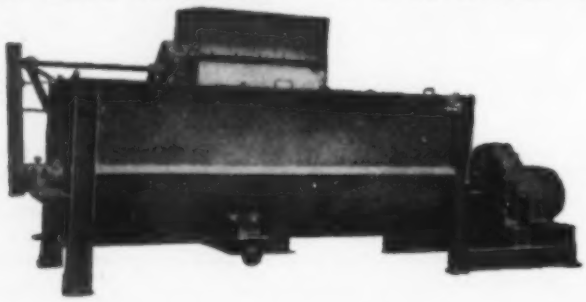

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Maintenance of Lamps & Motors	Mar. 1943
Maintenance in Process Industries	Dec. 1940
Market Research	May 1946
Materials of Construction	Oct. 1926; Sept. 1928; Sept. 1929; Sept. 1932; Oct. 1934; Oct. 1936; Nov. 1938; Sept. 1940; Sept. 1942; Sept. 1944; Nov. 1946
Materials Handling With Trucks	Nov. 1945
Mechanical Handling	Apr. 1930
Mechanical Maintenance	Apr. 1943
Mechanical Power Transmission	July 1940
Measurement & Control of pH	Aug. 1940
Measurement & Control of Process Variables	May 1943
Mechanico-Chemical Processing	May 1938
Middle Western Progress	Aug. 1946
Middle Western Resources	Nov. 1942
Midwestern Chemical Industries	Apr. 1941
New England	Sept. 1943
New Tools for Process Control	July 1945
Opportunities in Petroleum Refining	June 1940
In Pulp & Paper Industry	Apr. 1940
In Synthetic Organic Chemicals	Oct. 1941
Oxygen	Jan. 1947
Pacific Northwest	June 1944
Pacific Progress	Sept. 1947
Paints & Varnishes	Nov. 1944
Petroleum Processing	June 1945
pH Measurement & Control	Aug. 1940
Planning Research	Aug. 1947
Plant Design & Construction	May 1941
Plant Lighting	Jan. 1940
Plant Lubrication	Mar. 1940
Plant Protection in Wartime	Jan. 1942
Plant Safety & Fire Protection	Oct. 1940
Postwar Prospects	Feb. 1943
Power Show	Dec. 1942; Dec. 1944
Process Control	Apr. 1929
Process Equipment Design	May 1939
Process Improvement	June 1947
Process Steam & Power	Aug. 1941
Production, Application & Transfer of Heat	May 1944
Public Relations	Oct. 1938
Recent Advances in Fermentation	Dec. 1947
Small Business	Dec. 1944
South America & West Indies	Dec. 1943
Southern Chemical Progress	July 1941
Southwestern Progress	June 1942
Steam in Ch. E. Industry	Sept. 1927
Speeding Production	Nov. 1941
Surplus Property	Oct. 1945
Synthetic Fibers	Jan. 1945
Technical Service	Mar. 1945
Unit Operations Appraisals	May 1934
Unit Operations Development	Apr. 1935
Wartime Construction	July 1942
Waste and Process Planning	Aug. 1945
Waste Disposal & Byproduct Recovery	Sept. 1931
Water Treatment	June 1941
Weight Control	Apr. 1946
Western Process Industries	Sept. 1941
West Indies	Dec. 1943
What Fuel, How Efficient?	Apr. 1932

An Index to *Chemical Engineering* Pictured Flowsheets, 1939-1947

Acetic Acid (wood)	May 1940
Acid-Grade Fluorspar	Aug. 1945
Acid Regeneration	July 1946
Activated Sludge	Jan. 1941
Alcohol Byproducts	June 1945
Alcohol From Petroleum	Nov. 1945
Alcohol (molasses)	June 1939
Alkali Industry	Feb. 1946
Alumina	Oct. 1940
Aluminum Sheet	May 1943
Ammonia Soda Process	Feb. 1942
Ammonia Synthesis TVA	Nov. 1943
Ammonia (synthetic)	Dec. 1945
Amyl Alcohol and Acetate	July 1940
Ball Powder	Dec. 1946
Bauxite	May 1943
Bead Catalyst	Apr. 1946
Beer	July 1942
Beet Sugar	June 1949
Bromine (seawater)	Dec. 1939
Buna S Rubber	June 1943
Butyl Rubber	July 1943
Calcium Hypochlorite (and Mg)	Apr. 1945
Cane Sugar	July 1941
Carbon Dioxide	Feb. 1939
Casein and Lactic Acid	June 1940
Catalyst (synthetic bead)	Apr. 1946
Caustic Soda	Dec. 1942
Cellophane	Jan. 1939
Cellulose Acetate Yarn	Jan. 1945
Cement (wet process)	Oct. 1939

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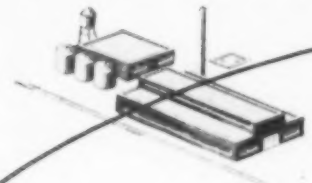

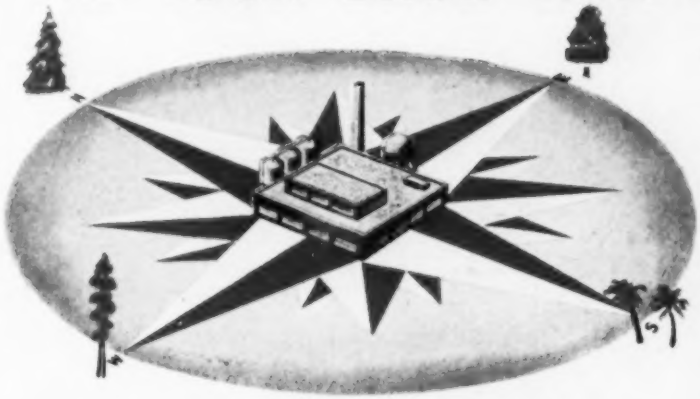

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Newell, Pa.
NEW ORLEANS WORKS
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Pulaski, Va.
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The STEVENS Line offers a type and size for every chemical and food plant need. Write us for literature.

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REPUBLIC STEEL

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METAL BARRELS AND DRUMS

Chemical Cotton	Apr. 1941
Chlorine	Dec. 1942
Cigarette Paper	June 1946
Coke (byproduct)	Dec. 1941
Continuous Pulp Bleaching	Oct. 1947
Continuous Separation of Fatty Acids	Nov. 1946
Continuous Soapmaking	Apr. 1947
Copra Refining	Feb. 1945
Cordite	Oct. 1943
Cyanamide	Apr. 1940
Dedorizing Edible Oils	Sept. 1946
Delayed Coking	Feb. 1947
Diatomite	Aug. 1942
Ethyl Cellulose	Sept. 1945
Fatty Acids (separation)	Nov. 1946
Fertilizer (mixed)	July 1947
Fiber Glass Production	June 1947
Fluorspar (acid-grade)	Aug. 1945
Formaldehyde	Sept. 1942
Furfural Production	July 1945
Furfural Refining (lubricants)	Dec. 1940
Gasoline (aviation)	Dec. 1943
Glass (plate)	Jan. 1942
Glassine Paper	Nov. 1947
Glycerine (and red oil)	Sept. 1943
Glycerine and Soap	May 1942
Grain (continuous cooking)	Oct. 1944
Grain Alcohol	June 1945
Hydrogen	May 1946
Hydrogen Sulphide	Jan. 1940
Lactic Acid	June 1940
Leather (chrome)	Jan. 1943
Liquid Oxygen	Mar. 1947
Lubricants (dewaxing)	Oct. 1941
Lubricants (refining)	Dec. 1940
Magnesium (carbothermic)	June 1944
Magnesium Chemicals	Aug. 1947
Magnesium From Minerals	May 1944
Magnesium Metal (and $Ca(OCl)_2$)	Apr. 1945
Magnesium (sea water)	Nov. 1941
Mixed Fertilizer	July 1947
Molasses Distillation	May 1945
Naval Stores	Mar. 1942
Neoprene	Jan. 1944
Nylon Production	Mar. 1946
Oil (vegetable)	May 1947
Oils (deodorizing)	Sept. 1946
Orange Products	Sept. 1944
Oxygen (liquid)	Mar. 1947
Paint	Mar. 1939
Paint and Varnish	Mar. 1945
Paper (cigarette)	June 1946
Paper (glassine)	Nov. 1947
Penicillin	Apr. 1944
Phenol	Apr. 1939
Phenol	Nov. 1940
Phenol	Sept. 1947
Phenol Plastics	Mar. 1940
Phenolic Resin	Sept. 1939
Phosphates	May 1939
Phosphates (super)	Apr. 1943
Phthalic Anhydride	Aug. 1946
Porcelain	July 1939
Potassium Perchlorate	Dec. 1944
Powder (smokeless)	Apr. 1942
Pulp (continuous bleaching)	Oct. 1947
Pulp (sulphate)	Nov. 1939
Pulp (sulphate bleaching)	Mar. 1944
Pulp (sulphite)	Aug. 1941
Rayon (staple fiber)	Aug. 1944
Rayon (viscose)	Jan. 1939
Rayon (viscose)	Oct. 1942
Rosin and Terpene Oils	Dec. 1947
Rubber (reclaim)	June 1941
Salicylic Acid	Aug. 1943
Salt	Aug. 1940
Searles Lake Chemicals	Oct. 1945
Silica Aerogel	Feb. 1943
Soap	May 1942
Soapmaking (continuous)	Apr. 1947
Sodium Chlorate	Nov. 1944
Terpene Oils (and rosin)	Dec. 1947
Soybean Extraction	Sept. 1941
Stearic Acid	Sept. 1943
Stoneware (chemical)	Sept. 1940
Streptomycin	Oct. 1946
Strontium Chemicals	Jan. 1946
Styrene (Dow process)	Feb. 1944
Sugar (beet)	June 1942
Sugar (cane)	July 1941
Sugar (refining)	Feb. 1940
Sulphur (from coke-oven gas)	July 1944
Sulphur (mining)	Mar. 1941
Sulphuric Acid (sludge)	May 1941
Synthetic Ammonia	Dec. 1945
Synthetic Bead Catalyst	Apr. 1946
Varnish and Paint	Mar. 1945
Vegetable Oil	May 1947
Whiskey	Nov. 1942
White Lead	Mar. 1943
Zinc Oxide	Feb. 1941

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NOT AN ENAMEL . . .

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The dependability and long life of the Lapp Valve is due to its sound design, and to the fact that it is made of *porcelain* . . . body, plug and packing rings. Not a coating or enamel, porcelain is a dense, homogeneous, thoroughly-vitrified ceramic, *non-porous,* through-and-through acid resisting. Not even is the corrosion-resistance of this material due to a glaze. In fact the "working parts" have no glaze. The smooth operation and pressure-tight seal characteristic of Lapp Valves result from precision-tolerance machining . . . grinding and lapping of solid porcelain to a mirror-like smoothness.

Valves and other equipment of Lapp Chemical Porcelain may be the answer to your corrosion problems. Write for literature. Lapp Insulator Company, Inc., Process Equipment Division, Le Roy, N. Y.

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PULSAFEEDER CHEMICAL PROPORTIONING PUMPS

faster cleaning

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STAINLESS STEEL EQUIPMENT

If quick cleaning is one of the factors that determines your use of stainless steel processing equipment, remember this:
A STAINLESS STEEL VESSEL WITH ROUND CORNERS CLEANS FASTER—MORE THOROUGHLY—THAN ONE WITH *SQUARE* CORNERS. Whether you clean with brush or cloth—you can "get at" all the surfaces of a round-cornered vessel easily. There are no corners in which residue can hide.

Having worked exclusively with stainless steel and alloys for many years, we have developed to a high degree the techniques needed to fabricate processing equipment with round corners.

Using tools and dies of our own design, we build your vessels so that cleaning time in your plant is cut to a minimum. Result: your stainless steel equipment costs less to operate and lasts longer. Consult with us.

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Guards Alloys in Fabrication

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A request on your letterhead will bring our guide, "What to Look For When You Specify Stainless Steel for Your Processing Equipment."

CORROSION RESISTANT PROCESSING EQUIPMENT

TANKS • KETTLES • STILLS • HEAT EXCHANGERS • AGITATORS • MIXERS • TOWERS • PIPING

(*Continued from page 111*)

tanks and tracks. About the plant are conglomerations of apparatus and columns, such as are familiar to all who pass by a petroleum-cracking plant.

Here, brought from mass-producing industry to the manufacture of medicines, is the result of modern chemical engineering science; here we see the alchemist's still and retort raised in an industry that takes hundreds of tons of raw materials through intricate processes to produce fine, pure chemicals.

Through the aid of chemical engineering we have been able to make available to the public quickly and at low cost the results of the invention of streptomycin by Dr. Selman A. Waksman.

Today only through the teaming of men, through groups working with other groups, have we been able to bring about the high development of the art and science of making fine chemicals.

In the case of streptomycin, from the isolation of the active principle by the soil-biologist, to final clinical tests prior to commercial debut on the world markets, many types of scientific services and skills were needed. Along with and in teamwork with chemical engineers must be mentioned microbiologists, geneticists, biochemists, and chemical specialists of all types, physicists, mathematicians and statisticians, plant engineers, pharmacologists, clinicians, and hundreds of plant and office workers, to say nothing of the integrated teamwork of corporate management.

I should like to refer back 15 years ago when our company built its first, complete, separate research and development laboratory in Rahway. To me this has always been a milestone, for it signified our transition from more or less individual, isolated scientific effort to modern teamwork. The individual is highly important still, but his stature and effectiveness are increased by being a member of a team. Fifteen years ago our management, at the dedication of this new laboratory, gave a pledge to the staff of our research laboratories and The Merck Institute for Therapeutic Research. We pledged that the enterprise should have our every aid and we assured the workers of our faith in them. We kept that pledge and our faith was rewarded and turned to still greater confidence—confidence in our team and in the organization that has developed from it.

NEWS FROM ABROAD

Special Correspondence

MORE PLANTS AND LABOR NEEDED IN BRITAIN TO MEET HIGHER CHEMICAL PRODUCTION TARGETS

A SATISFACTORY flow of fuel and raw material supplies enables British chemical manufacturers to operate at near-capacity levels, and high coal outputs in conjunction with mild weather have permitted further building of fuel reserves. Thus while the coal problem, the main production bottleneck of British industry, is somewhat easier, a new danger has arisen through transportation shortages. More use will be made of road transport for short-distance goods movement, but even so the railways will be exposed to a heavy strain this winter if all demands are to be met by their war-worn rolling stock. Another potential threat to smooth production arises from labor shortages which in some districts already have reached an acute phase.

So far the chemical industry has in general been able to attract sufficient labor by normal recruitment methods, partly because wages and working conditions compare favorably with those in other British industries and partly because increasing use of mechanical and automatic processes permits of employment of female labor, experience with which was satisfactory during the war. In some instances, however, new chemical projects had to be shifted to less favorable sites on account of fears that local labor recruitment might cause difficulties in otherwise preferable localities.

Uncertainties about the government's policy with regard to plant allocations under the curtailed program of capital expenditure have been partly removed by recent statements by official spokesmen. From these it would appear that plants and equipment required for output extensions will be obtainable, especially if the new capacity can make a direct contribution to export trade. This is true of most of the short-term extension schemes now under way.

Long Term Expansion

Most of the ambitious long-term modernization and expansion schemes, however, will be delayed and curtailed because of government insistence that chemical manufacturers should sell some of their products abroad. Moreover, steel and other construction materials will not be available for long-term projects which cannot make an immediate contribution to national production. Thus most of the big expansion schemes for alkalis, hydrocarbon chemicals, synthetic fertilizers and fibers will have to be revised. As building and equipment costs have risen substantially since these major projects were announced, a revision would be necessary in any case on purely economic reasons.

Suspension of big extension schemes announced earlier has been reported in only one case. The British Aluminum Co. and the Imperial Smelting Corp. have decided to suspend expenditure on the Magnesium Metal Corp.'s carbo-thermic process of magnesium production, but this decision was actuated by the fact that additional magnesium supplies are not needed in Britain and the world outlook does not justify further investments. Other companies report their extension schemes are being held up by shortages of construction materials and delays in delivery of machinery, but if the government does not state which capital expenditure projects must be abandoned or suspended most producers will carry on with their plans so long as there is hope of obtaining the necessary materials and equipment.

In accordance with its declared policy to curtail raw material imports only if absolutely essential to prevent a collapse of sterling, the government has not greatly changed its import control policy though licenses for some commodities are rather more difficult to obtain and considerable attention is devoted to development of soft-currency sources for goods previously imported from hard-currency countries. In general, stocks of chemical raw materials seem to have declined in the past two years, especially if compared with expanding consumption. On the whole it may be said that the supply

War crimes charges have been made against these I. G. Farben officials. They are shown as they entered not guilty pleas at Nurnberg. In the dock, front row, are defendents C. Krauch, H. Smitz, G. von Schnitzler, F. Gajewski, H. Hoerlein, A. von Knieriem, F. Ter Meer, C. Schneider, O. Ambros, E. Buergin, and H. Buetefisch. In the rear are P. Haefliger, M. Ilgner, F. Jachne, H. Kuehne, W. Mann, H. Oster, W. Duerrfeld, H. Gattineau, E. von der Heyde and H. Kluger.

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Whether your problem is mixing, blending, suspending or dissolving, you can handle it simply and economically with an Alsop "*Hy-Speed*" Mixer or Agitator.

Perhaps we can help you solve your mixing problem; write us giving details of liquids and quantities to be handled.

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National Airoil Fuel Oil Pumping and Heating Units are especially designed to prepare, for combustion, what is commonly termed No. 6 or Bunker C Fuel Oil. They will draw fuel oil from above ground or underground tanks, preheat it to proper constant temperature and deliver it to Oil Burners at an even pressure, best suited for the burners. Our Fuel Oil Pumping and Heating Units are the result of years of experience. They come completely equipped ready for steam, exhaust, condensate, oil suction, oil return, and where motor driven pumps are used, electrical connections. All valves, regulators, etc., are readily accessible. The piping arrangement is easily understood. These compact, space-saving units are available in a range of sizes and models in both Medium and High Pressure types. For complete details, write for our Bulletin 40—very interesting and informative.

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

position for most imported materials is more satisfactory than for some home-produced basic products such as soda ash and caustic soda.

Currency Problem

The currency argument is certain to exercise much influence on government policy with regard to projects for the production of carbon blacks, organic chemicals, tanning agents and other products now largely imported from the Americas. For casein which used to be imported largely from the Argentine, a soft-currency source is said to have been found. Other agricultural byproducts, it is hoped, will become available in increasing quantities from sterling sources, and the cultivation of oleageneous plants is to be encouraged on a large scale in the African colonies. Potash and phosphates are available from Palestine, France and Germany and from French North Africa and sterling area islands in the South Sea. Thus, if hard-currency economy is the over-riding consideration, further savings are possible, though only at the cost of considerable inconvenience and heavy demand for shipping space. British demand for many synthetic chemicals from North America, however, can be reduced only by expansion of production of similar products, possibly from different raw materials, in Britain.

Export Trade

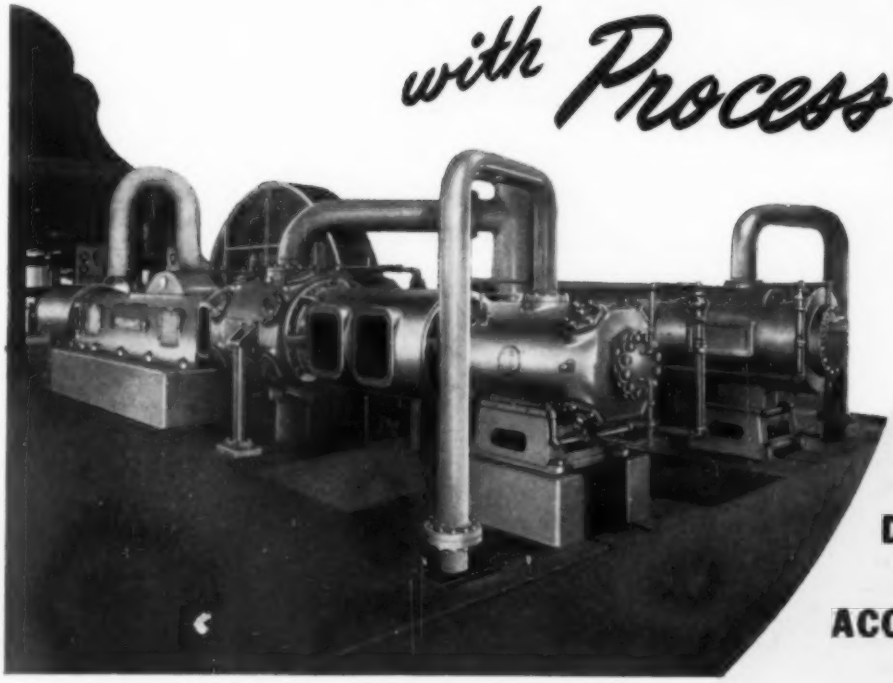
Chemical export trade continues to improve after the low figures of the summer, but home market demands, including needs of export industries, are so large that the surplus for direct exportation is limited. At present however demand from foreign customers is so pressing that any increase in production should immediately result in a corresponding increase in export sales. Uncertainties in connection with the extraordinary budget, the effect of fuel and raw material shortages, and the Geneva trade agreements have kept exporters from entering large forward commitments, but when these have been cleared up substantial contracts are likely to be concluded.

Soap Production in Italy Below Prewar Status

It is estimated that production of soap in Italy this year will be about 126,000 metric tons or approximately 80 percent of the prewar average. Formerly, about one-third of the country's production centered in the coastal regions of Liguria but with the decline

PROCESS COMPRESSORS

with Process-ability



SUITABILITY

CONTROL-ABILITY

DURABILITY

DEPENDABILITY

ACCESSIBILITY

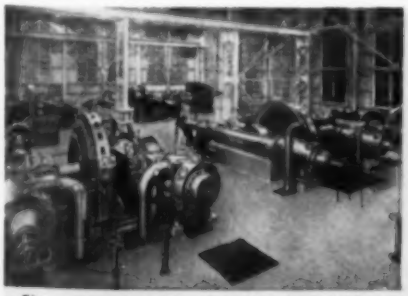
One of three 1200-hp, 3-stage, steam-driven gas compressors operating on high-pressure superheated steam against high back pressure in a chemical plant.

These are more than words! In a process plant, they represent values that cannot be measured in dollars first-cost, cubic-feet capacity, or horsepower of the compressor itself... but, more important, they must be measured in terms of sustained production, quality of product, and safety in operating both the compressor and the process.

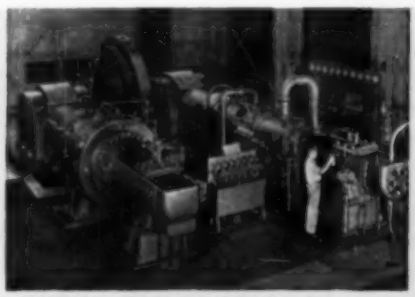
The best way to be sure a compressor has *Process-ability* is to select a manufacturer with years of actual engineering experience in building and applying compressors for all kinds of processes... for handling all sorts of gases... and for all ranges of pressures.

Ingersoll-Rand has that experience and can help you solve your compression problems.

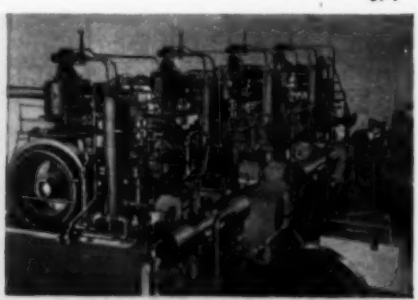
81-1



Six process compressors ranging from 200 to 1000 hp in a Chemical Plant. Each handles different gases at different pressures.



2500-hp, 7-Stage, electric-driven gas compressor operating at 15,000-psi discharge pressure in a synthetic-ammonia process.



Four 400-hp, 4-stage, electric-driven compressors discharging at 4000-psi pressure. (Four 100-psi compressors at lower right.)

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Can you Answer these Questions about HAMMERMILLS?

Q. *What are some of the important differences in various makes of hammermills?*

A. First and foremost is the degree of resistance to clogging when the material has high moisture content. Other differences involve: drying costs, capacity, power consumption, range of reduction, etc. All are important in terms of greater production at less cost.

Q. *What single difficulty is the one most often encountered in crushing operations?*

A. "Traffic jams" frequently result through inability of the average hammermill of conventional design to resist clogging in the handling of wet, clayey, sticky material.

Q. *Has this difficulty been successfully overcome?*

A. Yes . . . by the development on the part of Dixie engineers of a vastly improved crushing principle known as the Dixie Continuously Moving Breaker Plate.

Q. *Is the Dixie Continuously Moving Breaker Plate an exclusive Dixie feature?*

A. Yes . . . covered by U. S. Patents Granted and Pending.

Right! The Dixie Non-clog Continuously Moving Breaker Plate is the distinguishing characteristic of the famous Dixie Hammermill. Its time and money-saving features have practically revolutionized the reduction of raw materials in hundreds of installations all over the world. This singular record of accomplishment, proved in actual case histories, is your positive assurance that you *can do it better with a Dixie.*

Remember . . . there's only one Dixie. Don't be satisfied with anything less. For details request a copy of our helpful, informative bulletin, "More Efficient Crushing of Raw Materials."

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in imported fats and oils, plants in that area now produce only about 10 percent of the national total.

Contrary to the situation in some other countries, there is no scarcity of caustic soda but oils and fats are in small supply and the amount of coal alloted the soap plants is inadequate. The government does not permit the use of "valuta"—50 percent of the proceeds of exportation which remains at the free disposal of the exporter—for importation of raw materials for soap. Special import licenses are required and these are seldom granted.

Citric Acid Plant Under Construction in Latvia

According to press announcements, a pilot plant is being built in Latvia and will manufacture crystalline citric acid using molasses as a raw material. The reports say experimental work at the Scientific Research Laboratory in Riga, has shown that fermentation of molasses produced by the introduction of an acid-forming fungus, converts molasses into citric acid at a rate greater than where sugar is used as the raw material.

Brazil Requires Larger Imports of Alkalis

Brazil could use about 1,500 more tons of caustic soda and 1,000 more tons of soda ash monthly for its industrial requirements. Such is the finding of a survey recently made into the nation's needs for alkali. Brazilian industry requires a minimum of 3,500 tons of caustic soda and 3,000 tons of soda ash for proper operation of soap, paper, and glass factories as well as other industries. Only about half the amount it must import has been obtainable from the United States.

A plant to produce caustic soda and soda ash from native salt and lime deposits is being constructed at Cabo Frio in the State of Rio de Janeiro with the aid of a loan granted by the Export-Import Bank. Machinery is being installed by experts from the United States.

Monsanto Will Expand Australian Branch

Monsanto (Australia) Pty. Ltd. has obtained Treasury consent for an increase of its capital by £289,550 to £689,550. Dr. James H. Lum, who has been an executive director of Monsanto's Clinton Laboratories, Oak Ridge, Tenn., will serve as managing director of the Australian subsidiary. Most of the new capital will be subscribed by Monsanto Chemicals Ltd.

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COOPER can make immediate delivery from stock on Standard Type Stainless Steel Valves. These include: GLOBE · Y · NEEDLE · GATE · CHECK and QUICK-OPENING. The same prompt delivery can be given on Stainless Steel Pipe Fittings and Accessories.

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FIG. 100
150 lbs.
GATE VALVE
½ in. to 14 in.

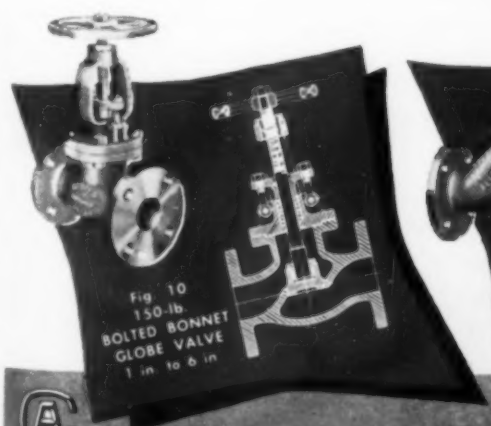

Fig. 10
150-lb
BOLTED BONNET
GLOBE VALVE
1 in. to 6 in.

Fig. 225
150-lb.
Y-VALVE
1 in. to 6 in.

Fig. 270
150-lb.
LEVER
THROTTLE
GATE VALVE
½ in. to 3 in.

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Write for Bulletin 42

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of England. Profits on these shares will not be subject to double taxation as they continue to be on straightout U. S. investments in Australia.

The new capital will be used to double output of phenolic molding powders and to expand the sulpha drug line. Other key products expected to profit from the expansion are salicylic acid and aspirin. A new factory is going up at Braybrook, Victoria.

Acquisition of I. F. Laucks, Inc., of Canada, by Monsanto Chemical will be duplicated in Australia by Amalgamation of Laucks Australia Pty. Ltd., Brisbane, and Monsanto Australia. Laucks Australia makes cold water glues for bonding of plywoods.

DIFFICULTY IN ACQUIRING RAW MATERIAL SUPPLIES AFFECTS PRODUCTION OF CHEMICALS IN HUNGARY

SHORTAGES of raw materials represent an even more serious problem to the chemical industry in Hungary than that of recovery from war damages. Sulphuric acid and oil refineries head the list of industries entirely destroyed by aerial bombardments in 1944 and 1945. The loss of sources of raw materials, however, has a more disastrous effect than the heaviest war destructions which are, incidentally, being repaired very quickly.

Practically all of the 340 chemical plants of the country have resumed work, and the number of employed workers has reached the prewar level. In peacetime, the chemical industry imported raw materials in the approximate amount of $20 million per year. After the war this became impossible. Germany, formerly the main supplier of Hungary is no longer in the field and lack of sufficient trade agreements with other countries causes a headache to the industry.

Two consecutive dry years decreased agricultural exports and thus lowered chances of producing hard currency for imports of raw chemicals. Droughts also had a direct effect on the chemical industry since they paralyzed the agricultural branches of the industry, such as production of alcohol and starch, and did not allow full capacity production in those branches which use animal byproducts. The most essential basic raw materials, such as salt, nitric acid, raw phosphates and resins are scarce or lacking and it is still unknown from where some of these and other essential raw materials will be procured. Some salt is being imported

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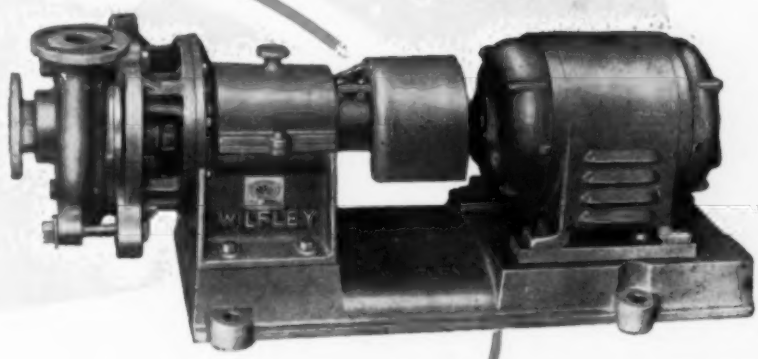
FOR

Acids



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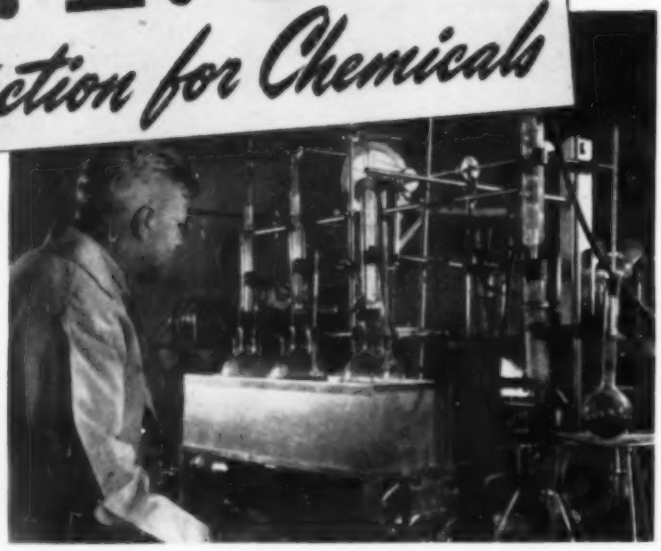
Protection for Chemicals



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from Roumania, pyrites from Jugoslavia and raw phosphates from France.

Another difficulty is in connection with the coal problem. In 1939, chemical industries used 600,000 metric tons of coal. This demand cannot be met under present circumstances, since domestic coal production has not reached prewar levels, and the quality of Hungarian coal is low.

Resume Production

In spite of the difficulties, production of many chemicals has been resumed. Hungaria Vegyi Es Kohomuvek (Hungarian Chemical and Metallurgic Works), Budapest, is manufacturing fertilizers, synthetic dyes and glues, various acids such as sulphuric, hydrochloric and chlorsulphonic, caustic soda, sodium sulphide, and sunflower-seed oil.

Peti Nitrogen Muvek (Nitrogen Factory of Pet), Pet, Hungary, produces carbon bisulphide and ethylene trichloride; Hungaria Viscosa, Ltd. added synthetic silk and cellophane to the resumed activity of its chemical division.

The Ipartermek Ertekesito Ltd., Budapest, developed manufacture of activated carbon and wood flour. The gas company of the City of Budapest resumed production of benzol as one of their important byproducts and developed the tar distillery. It is anticipated that domestic production of phenol, creosote and carbamide will help in reducing hitherto necessary imports.

New Manufactures

The Arzola Plants, Budapest, Mercur Ltd. and Nitrokemia Ltd., Budapest, together with the formerly mentioned Hungaria and Peti Nitrogen Muvek, introduced as new branches of domestic production of chemicals the manufacture of anilin, acetanilide, acid benzoic, phenacetin, phenatedin and furfurol, as well as synthetic dyes.

The Dr. Balint Chemical Factory, Budapest, and Superkemia Ltd., Budapest, began manufacture of nickel sulphate and chemically pure silver compounds.

In the chemical field, State Control projects have been confined to certain branches of the serum industry, but no plants are actually nationalized. The government, however, is empowered to fix prices and production is entirely controlled by the Minister of Agriculture.

In case of government contributions to plant-expansion costs, the State becomes co-owner in proportion to its investment. Distribution of products

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A special corrosion-resistant alloy, containing high chromium and nickel with molybdenum and low carbon. (Other materials available for special services.)
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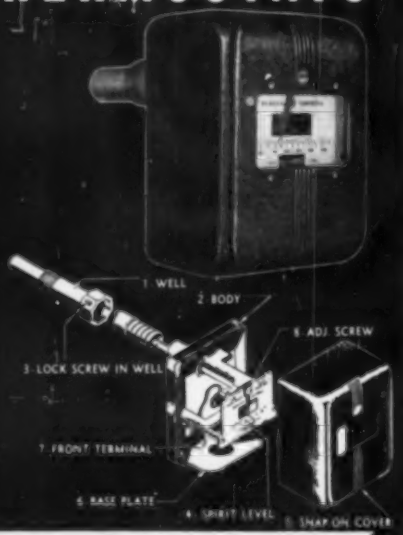

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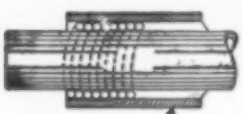

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★ The use of Vitreosil for Gas Sampling is fully covered in Vitreosil Bulletin No. 3. We will be glad to send you a copy; also to answer any specific questions you may care to ask us. Write for Bulletin 3.

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exports and imports, are also subject to government control, and the State may establish corporations (state-owned) for production of certain serums which the Minister of Agriculture may specify.

Similar measures have been suggested in connection with the production of fertilizers and chemicals for protection against plant parasites. Copper sulphate is now being manufactured by Hungaria Vegyi És Kohó Müvek and carbon bisulphide by the Péti Nitrogén Müvek, Pét, Hungary. Besides these two plants, eight others are engaged in the manufacture of packaged specialties to be used against plant parasites. These products were, even before the war, subject to a limited governmental control. They may be distributed only if experiments of the Ministry of Agriculture have proved their efficiency, and the government makes spot checks to ascertain that the approved material and the distributed products are identical.

Soda Ash More Plentiful In Argentine Markets

SHORTAGE of soda ash and caustic soda which only recently was critical in Argentina has been alleviated by the appearance of substantial quantities on the market.

Normal soda ash consumption in manufacture of glass, is about 40,000 to 50,000 tons per year. This demand has not been met for some time.

However, quantities of up to one thousand tons are being offered at prices from three to four times the normal value, and this is not considered prohibitive by manufacturers in view of the vital importance of the material. The ash offered is mostly North American, but important lots are also being offered from France, Czechoslovakia and elsewhere.

Large Growth in Use of Rubber in India

DEVELOPMENT of a rubber price and import policy acceptable to both the producing and the processing industries is the task set before the recently-established Indian Rubber Board which met recently in New Delhi for its first session.

Since 1939, when domestic consumption was only 5,600 long tons out of a total production of about 16,000, use has shot up to the point where the current production of about 17,000 tons is insufficient.

A total of 50,000 persons is employed in the rubber-growing industry and the market value of the crop runs

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- ✓ **Strength to withstand pressure and vibration.**
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- ✓ **Sizes range from 2-in. IPS through 14-in.**
- ✓ **Can be produced to special diameters which may be required.**

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to slightly more than $10 million. Ways and means are to be sought to step up production for the Indian output per acre of plantation is among the lowest in the world.

Russia Develops Supply Of Colloidal Sulphur

An effective preparation for fighting blights and pests, called colloidal sulphur or gas sulphur paste, has been developed by the Scientific Institute for Fertilizers and Insectofungicides of the Soviet Ministry for the Chemical Industry. The sulphur is obtained from coke-oven and produces gases by stripping them of hydrogen sulphide by the arsenic-soda method. To make the sulphur soluble in water so it may be used for spraying, a one percent solution of sulphite cellulose is applied in the final washing out of the sulphur.

Foreign News Briefs

Distillers in Pernambuco State, Brazil, recently sold more than 500,000 gal. of non-dehydrated alcohol to Portuguese buyers. This is the first large export sale of alcohol of this type made by Brazil.

Despite a world shortage in vegetable oils, Argentine farmers have reduced by about 10 percent the acreage sown to linseed this year. The estimated planting is 1,712,000 hectares or only 82.6 percent of the last five-year average.

Pyrites from the Norseman deposits near Wiluna, Western Australia, will be used by Wiluna Gold Mines Ltd. in a process developed by the company to recover residual gold in cyanide tailings.

First Dutch plant for manufacture of cellulose products will be established at Deventer, Holland, after conclusion of a working agreement with American Viscose Corp. Production is expected to start early next year.

An international exhibition devoted to applied chemistry will be held next September at the Universite Du Travail Paul Pastur, Charleroi, Belgium. The Congress of Industrial Chemistry, organized by the Association of Industrial Chemistry with headquarters in Paris, will take place in Charleroi at the same time.

Three companies in France produce synthetic camphor with an annual output of about 360 metric tons. Attempts are being made to increase production which, at present, is not sufficient for home requirements.

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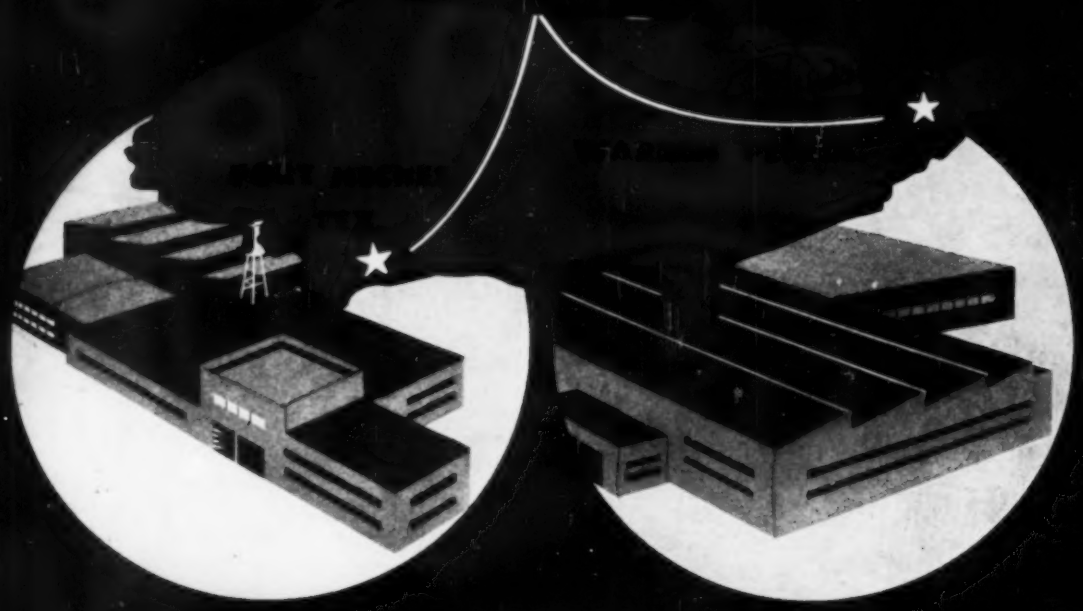

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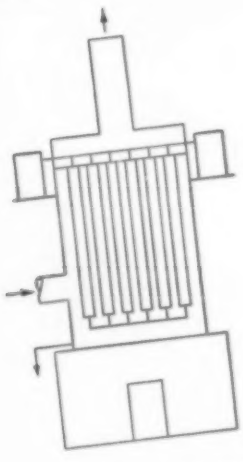

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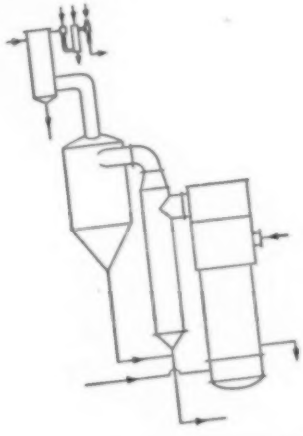

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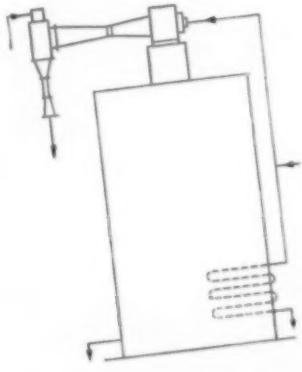

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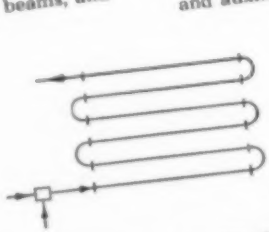

Acid-Dilution Equipment — 66 deg. Be. H_2SO_4 "cut" to any lower concentration quickly and economically with **"Karbate" Impervious Graphite** mixers, coolers, pumps, pipe, fittings, and valves.

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Sodium Chloride Versus Construction Materials

Part III of a symposium in which typical materials of construction are evaluated for services involving sodium chloride. Part IV will be published next month.

NICKEL, NICKEL ALLOYS

W. Z. FRIEND
International Nickel Co.
New York, N. Y.

MONEL, nickel, Inconel and the Ni-Resist alloys have a high degree of resistance to sodium chloride and brine solutions under practically all conditions of concentration, temperature and aeration. Monel, nickel and Ni-Resist are being used for a great many applications in the production of salt and in its utilization in such processes as soap manufacture, caustic soda and chlorine production, food brining and refrigeration. Applications of Monel in salt production include grainer rakes, drain boards, filters, filter cloth, pump rods and impellers, hoppers, chutes, centrifuges, screens, rotary dryer linings and flights, screw conveyors, elevator buckets, chins, shovels, picks, piping, evaporator tubes, weighing and packaging machinery, and miscellaneous fittings. The usefulness of Monel in a number of these applications results from its resistance to abrasion by crystalline salt as well as to corrosion.

Nickel or nickel-clad steel is used for such equipment as salt dissolving and brine storage tanks, soap lye treating and storage tanks, evaporator tubes and coils in such industries as soap, caustic and food processing. The Ni-Resist austenitic cast nickel-iron alloys are used for such equipment as pump casings and impellers, valves and cast pipe handling brines, and for bodies and plates of filter presses and rotary salt filters. Type 1 Ni-Resist (14 Ni, 6 Cu) and Type 2 Ni-Resist (20 percent Ni) usually are used for brine service except where the parts are subject to severe thermal shock. Under such conditions, the relatively high expansion coefficient of these two types may possibly make them subject to cracking, and the use of Type 3 Ni-Resist (30 percent Ni) having low expansion coefficient, is desirable. For example, in a filter press handling spent soap lye at 175 deg. F. and washed out with cold water after each filtration, it was found that Type 3 Ni-Resist was required for filter plates for this reason.

The results of a number of laboratory corrosion tests in sodium chloride solutions are shown in Table I. The results of plant tests in connection with the production of common salt are given in Table II. Other tests in the treatment of spent soap lye involving sodium chloride are covered by Table III. Inconel may occasionally be subject to localized attack or pitting in hot chloride solutions under low velocity conditions. Such attack when it does occur, usually is shallow and non-progressive, and serious pitting is not common. Inconel-clad steel evaporators with Inconel tubes have

Table I—Laboratory Corrosion Tests in NaCl Solutions

Test 1. In air-saturated solution; 3.5 percent NaCl; 86 deg. F.; 30 days duration; velocity 16 ft. per min.
Test 2: In air-saturated solution; 3.5 percent NaCl; 212 deg. F.; 7 days duration; quiescent.
Test 3: In air-saturated solution; 6 percent NaCl; 86 deg. F.; 4 days duration; quiescent.
Test 4: In spray; 6 percent NaCl; room temp.; 30 days duration.
Test 5: In 10 percent NaCl solution; boiling; 12 days duration.
Test 6: In spray; 20 percent NaCl; 100 deg. F.; 97 days duration.
Test 7: In spray; 20 percent NaCl; 95 deg. F.; 62 days duration.
Test 8: In air-saturated solution; 26 percent NaCl; 187 deg. F.; 2 days duration; velocity 16 ft. per min.
Test 9: In saturated refrig. brine; 18 deg. F.; 90 days duration.
Test 10: In spray from above refrig. brine; 18 deg. F.; 90 days duration.

	Corrosion Rate, Mils Per Year			
	Monel	Nickel	Inconel	Ni-Resist (Type 1)
Test 1	1.0	1.0	0.1	9.0
Test 2	0.3	—	—	—
Test 3	0.1	0.2	—	—
Test 4	0.05	0.03	—	—
Test 5	1.7	—	—	—
Test 6	0.3	—	—	—
Test 7	—	0.2	—	—
Test 8	—	—	—	5.4
Test 9	0.06	0.1	0.1	3.0
Test 10	0.3	0.3	0.2	3.6

Table II—Plant Corrosion Tests in Salt Production

Test 1: In vapor section of tubular salt evaporator; 210 deg. F.; 210 days duration.
Test 2: In vapor under hood of Alberger evaporator; 120 deg. F.; 141 days duration.
Test 3: In salt grainer, immersed in sat. sol. plus crystals; 180 deg. F.; 60 days duration.
Test 4: In salt grainer inlet; alternate exposure to sat. sol. and to steam and air; 200 deg. F.; 30 days duration.
Test 5: In saturated brine and salt cake beneath grid of Oliver filter; 200 deg. F.; 145 days duration.
Test 6: In saturated salt slurry in chute of Oliver filter; aerated; 90 deg. F.; 90 days duration.
Test 7: In saturated brine leaving Oliver filter; 100 deg. F.; 28 days duration.
Test 8: In spray of saturated brine and air in pit beneath centrifuge; 190 deg. F.; 180 days duration.
Test 9: In saturated mixture of NaCl and KCl in potash refining; at brine surface in tank; 120 deg. F.; 31 days duration.
Test 10: In natural brine containing 5 percent NaCl and 4.5 percent KCl being pumped at velocity of 1 ft. per sec.; 70 deg. F.; 35 days duration.
Test 11: In brine containing 225 gpl. NaCl and 160 gpl. KCl with 20 percent crystalline NaCl in suspension; aerated; velocity 30 ft. per min.; 130 deg. F.; 45 days duration.
Test 12: In rotary salt dryers; oil fired; dry end.
Test 13: In rotary salt dryers; oil fired; wet end.
Test 14: In rotary salt dryers; steam heated; wet end.
Test 15: In mixture of sodium, calcium and magnesium chlorides being evaporated to 28 percent total chlorides in evaporator; boiling under vacuum; 160 deg. F.; 31 days duration.
Test 16: In mixture of calcium and magnesium chlorides being evaporated to 50 percent total chlorides in evaporator; boiling under vacuum; 26 days duration.

	Corrosion Rate, Mils Per Year			
	Monel	Nickel	Inconel	Ni-Resist (Type 1)
Test 1	0.2	0.2	0.1[1]	0.3
Test 2	—	—	—	3.5
Test 3	0.2	0.2	0.1	0.4
Test 4	2.6	2.1	1.3	4.9
Test 5	0.2	—	—	1.6
Test 6	6.0	3.0	1.6[2]	8.0
Test 7	1.8	3.3	—	5.0
Test 8	0.1	0.1	—	—
Test 9	1.5	0.7	0.07	3.0
Test 10	0.5	1.2	0.03	3.7
Test 11	2.3	2.9	2.0[3]	3.3
Test 12	11.0	—	—	—
Test 13	14.0	—	—	—
Test 14	1.1	—	—	—
Test 15	0.6	0.7	0.1[4]	2.7
Test 16	2.0	2.7	0.1	3.7

[1] Pitted to maximum depth of 8 mils (0.008 in.). [2] Pitted to maximum depth of 15 mils. [3] Pitted to maximum depth of 7 mils. [4] Pitted to maximum depth of 5 mils.

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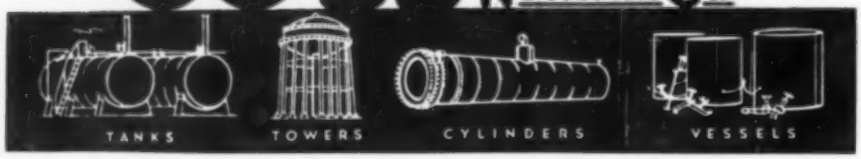

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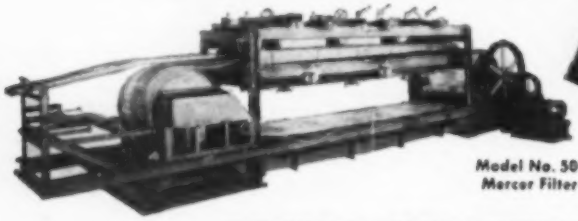

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been used successfully for evaporation of magnesium chloride solutions.

Monel, nickel, Inconel and the Ni-Resist alloys are usefully resistant to corrosion by sea water. With Monel, nickel and Inconel, conditions of relatively high velocity are most favorable. In stagnant exposure the accumulation of marine organisms may induce pitting of these materials. Monel is used for such equipment as sea water pumps, rods and valves, boat propeller shafts and a wide variety of marine fittings. Ni-Resist is used for pumps, valves, piping and other equipment where a cast material is required.

None of these is subject to stress-corrosion cracking in chloride solutions.

Table III—Plant Corrosion Tests in Processing of Sodium Chloride Solutions Resulting from Soap Manufacture

Test 1: In treating tank during acid treatment of spent soap lye; to mixture of 13 percent NaCl and 4.5 percent glycerine is added 150 lb. of 28 percent HCl and 75 lb. of 17 percent aluminum sulphate per 30,000 lb. soap lye; 30-180 deg. F.; 167 days duration.

Test 2: In treating tank during alkali treatment of acidified soap lye containing 13 percent NaCl and 4.5 percent glycerine; 25 lb. of 50 percent NaOH added to 30,000 lb. of solution; 160-180 deg. F.; 123 days duration.

Test 3: Specimens 20 in. from top of treated soap lye storage tank, so alternately immersed and exposed to vapor. Approximate composition: 10-12 percent glycerine, 13-16 percent NaCl plus Na_2SO_4; 165-185 deg. F. (average 175 deg. F.); 105 days duration.

Test 4: In liquid above top tube sheet of evaporator during evaporation of treated soap lye; initial concentration: 13 percent NaCl, 4.5 percent glycerine; final concentration: 8 percent NaCl, 81 percent glycerine; 175 deg. F.; 63 days duration under vacuum.

Test 5: In tank through which salt-glycerine slurry from crude glycerine evaporator circulates to Bird centrifugal; composition of liquid: 24.9 percent NaCl, 34.3 percent glycerine, 1.8 percent Na_2SO_4, 0.001 percent free Na_2O; composition of crystalline solids: 81.8 percent NaCl, 16.1 percent Na_2SO_4; agitated with air; 100-220 deg. F. (average 150 deg. F.); 30 days duration; immersed in slurry approximately one third of time; subject to wash from feed pipe balance of time.

Test 6: In salt brine tank in solution of salt recovered from glycerine evaporator; heated by live steam injection; 100-200 deg. F.; 78 days duration.

Corrosion Rate, Mils Per Year

	Monel	Nickel	Inconel	Ni-Resist (Type 1)	Ni-Resist (Type 2)
Test 1	0.9	1.1	0.6	2.5	2.7
Test 2	0.7	0.8	0.5	1.5	2.1
Test 3	0.1	0.4	0.1*	—	—
Test 4	0.1	0.1	0.1	0.5	0.1
Test 5	0.1	0.1	0.2	0.1	—
Test 6	0.4	0.4	0.4	0.6	1.4

* Pitted to maximum depth of 7 mils.

PROTECTIVE COATINGS

Most of the work that has been done on the use of protective coatings in the presence of sodium chloride or sodium chloride brines has been done in connection with exposure to sea water conditions. The information secured in sea water is not necessarily applicable to problems involving the handling of sodium chloride solutions that are relatively sterile.

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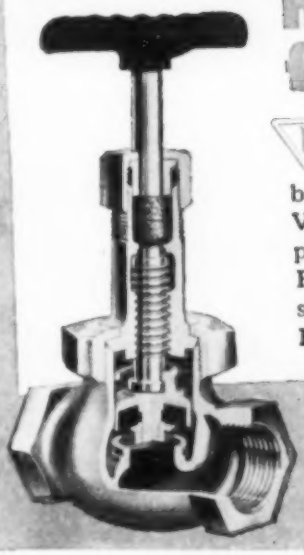

Fig. U-61
150 Pound COMPOSITION DISC GLOBE VALVE

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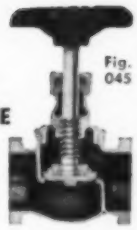

Fig. 045

Screwed-in Bonnet, integral seats. Rugged, compact with exceptional resistance to pressure and pipe strains. For steam, water, gas and oil – 125 lbs steam pressure.

REGRINDING Globe, Angle and Cross

Fig. 033

Bronze disc–integral seat–union bonnet–200 and 300 pound pressures. For higher pressure service where composition discs are not satisfactory

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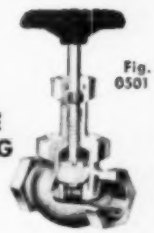

Fig. 0501

Nickel alloy seat and disc–union bonnet–200 and 300 pound pressures. For more severe services on steam, water, oil, gas and air.

PLUG DISC AND SEAT Globe and Angle

Fig. 0501-P

Renewable hardened nickel alloy seat and disc–200 pound pressure. For throttling and other service requiring close regulation of flow.

NON-RISING STEM Gate Valves

Fig. 0250

Screwed bonnet – solid wedge – taper seat 125, 150 and 300 pound pressures. For full flow of steam, water, oil and gas.

RISING STEM Gate Valves

Fig. 0228

Screwed bonnet – split wedge – solid wedge for 125 and 150 pound pressures. For steam, water, oil and gas.

OUTSIDE SCREW AND YOKE Gate Valves

Fig. 0209

Screwed bonnet – solid wedge – taper seat – 150 and 300 pound pressures, where operating threads must not contact fluids.

UNION BONNET Gate Valve

Fig. 0230

Non-rising stem – nickel alloy wedge–integral seat–200 pound pressure. For higher pressures on steam, water, oil and gas.

Fig. 0601

SWING CHECK VALVES

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Fig. 0616

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The living organic life in sea water has a deleterious effect on many organic coatings. Most paint film materials have fairly good resistance to sodium chloride solutions, and the main difficulty in trying to protect equipment against fog or solutions containing sodium chloride is the penetration of the film and subsequent corrosion and rusting of the parent metal. The oleo resinous varnishes, with either a drying oil plus a natural resin or a synthetic resin, have good resistance. Spar varnish has been widely used, and the chlorinated rubber base varnishes have been quite successful. Most of the plastic base paints have good resistance to sodium chloride solutions including the phenol formaldehyde resins, the melamine formaldehyde, the urea formaldehydes, the polyvinyl chlorides, the vinylites and the alkyds. Some of the tar base paints have shown excellent resistance to sodium chloride brine.

Brine storage tanks or any other use in constant contact with sodium chloride brine must have a very good surface preparation. It is usually desirable to use a suitable primer and enough coats of the material chosen so that there will not be penetration of the film by the brine or water vapor. The baked-on coatings have been more successful than the air-dried coatings.

Some evidence indicates that white lead is not a desirable pigment for use in contact with sodium chloride brines. Substitution of blanc fixe for white lead in the Navy's specification for battleship gray, gave improved life.

The author of this article is with a large chemical company which uses, but does not produce, protective coatings.

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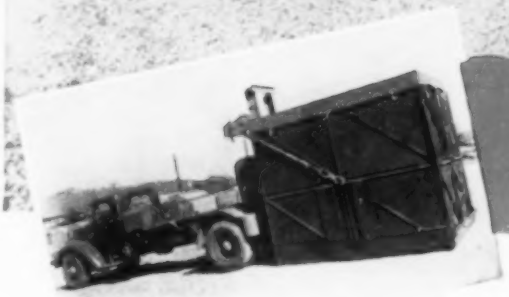

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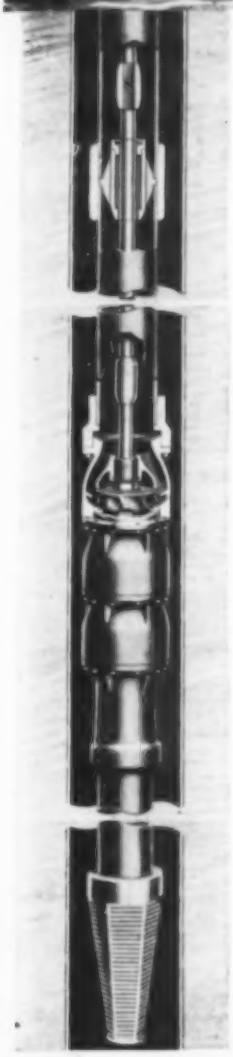

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Lead shows only slight corrosion (4 or 5 mils per yr.) when exposed to 1 normal sodium chloride and practically no corrosion when exposed to salt spray. Corrosion resistance of lead to salt water is well illustrated by the wide use of lead pipe in handling sea water supplies to aquariums throughout the country. Tropical salt water fish were put on display in 1927 in the Miami (Fla.) Floating Aquarium. The original piping was not lead and served only 18 months before requiring replacement. Corrosion in the original pipe so clouded the water that the specimens could not be distinguished. This was completely corrected by the use of lead pipes, cocks and valves throughout.

Among an extensive list of aquariums using lead for salt water corrosion resistance is the Shedd Aquarium in Chicago which was completed in 1929 or 1930. Aquarium authorities recently assured us there is no question but that lead pipe had given satisfactory service. The only physical change observed is that an undisturbed lining of lead oxide or lead oxychloride has formed within the pipes. All the water used for both fresh and salt water fish is handled in lead pipe and valves ranging in size from ¼ in. to 6 in. This water, shipped from off the Florida coast, is circulated through literally miles of lead pipe. Unsightly staining of the white Georgia marble building from moisture is prevented by liberal use of lead for roofing and decorative trim. (This practice is especially typical of seashore areas subject to salt spray.)

Over a period of four years lead bars were exposed in Bristol (England) Channel and the corrosion rates for soft lead and 1.6 percent antimonial lead were less than 0.3 mils per yr. There was no localized attack on these

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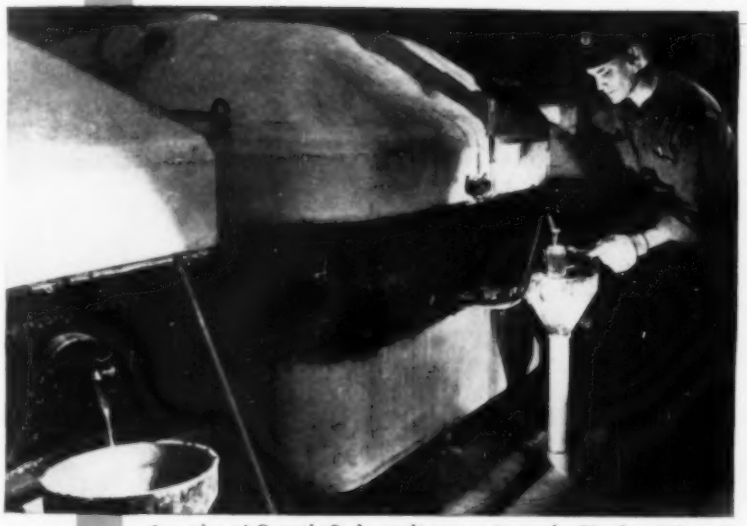

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HOOKER CHEMICALS

Aluminum Chloride Paradichlorbenzene Monochlorbenzene Sodium Benzoate Sulfur Chlorides Sodium Sulfide Sodium Sulfhydrate

Reduce your filtering costs!

THORATEX
REG. U.S. PAT. OFF.

IMPREGNATED COTTON FILTER FABRICS

—last longer
—reduce overhead
—increase output

HERE'S WHY

- Resistant to corrosive action of caustic and alkaline solutions
- Mildew and rot resistant
- Frequently outlast untreated fabrics three to one
- Maintain filtering capacity
- Smooth surface
- Cakes come away easily
- Reduce gumming
- Fewer washings required
- More continuous press operation
- Less shrinkage on press
- Non-capillary
- Better filtration
- Soft, flexible—sew easily

FREE TRIAL

Send us, prepaid, a roll of your cloth for finishing. Try it under actual plant operation.

Information and Samples on request.

METAKLOTH COMPANY
LODI, NEW JERSEY

bars which were submerged 93 percent of the time.

Another use for lead in contact with sea water is for soil and waste pipes aboard ocean-going liners where fresh water must be conserved and salt water is used for flushing with a resulting corrosion problem. In the four 17,000-ton luxury liners built in 1932 for the Grace Line, extensive use was made of lead for handling salt water. Space is at a premium in shipbuilding and flexible lead pipe is easily bent around obstacles and is less subject to damage from engine vibration and ship movement and buffeting. Aboard ship sheet lead was also used to line refrigerator rooms and for flashing in the joiner work on deck for its high resistance to sea air and sea water corrosion.

PRECIOUS METALS

E. F. ROSENBLATT
Baker and Co., Inc.
Newark, N. J.

Silver: Silver is recommended as a material of construction exposed to the corrosive influence of sodium chloride solutions where high purity of the solution has to be maintained. Silver clad material may be used where solid silver construction is too expensive. Great progress has been made in the production of electrolytic silver coatings free from pin holes.

Silver exposed to boiling sodium chloride solution loses approximately 0.14 mils per yr. increasing to approximately 2.8 mils per yr. if sodium chloride solution is aerated.

It is interesting to learn that silver piastres recovered from a sunken Spanish ship of the 17th Century were almost entirely converted to silver chloride showing that silver is not very resistant to sea water.

Molten sodium chloride attacks silver rapidly.

Gold: Gold in a boiling sodium chloride solution shows no loss even if the solution is aerated. Molten sodium chloride attacks gold appreciably, the metal being dissolved at a rate of approximately 22 mils per yr. at 850 deg. C.

Platinum: Platinum is more resistant than gold or silver to sodium chloride in solution or in the molten state. It has been used as the container in the production of large synthetic optical crystals from molten sodium chloride, and is to be recommended for use with sodium chloride at high temperatures whenever extreme purity is required. It is completely inert even under the highly corrosive condition of an anode in an electrolytic bath. Platinum clad anodes therefore are used in the manufacture of chlorates and perchlorates from sodium chlorate solutions. New developments foreshadow the use of platinum in the production of chlorine, in the form of an extremely thin layer of platinum on an inert metal.

Palladium: Palladium is highly resistant to boiling sodium chloride solutions. Aerated or unaerated, it shows a loss of only 0.05 mils per yr. It is, however, strongly attacked by molten sodium chloride, the average loss being approximately 12 mils per yr. at 850 deg. C.

TANTALUM

LEONARD R. SCRIBNER
Fansteel Metallurgical Corporation
North Chicago, Ill.

While many materials are sufficiently resistant to sodium chloride for most practical purposes under usual industrial conditions, tantalum is one of the few metallic materials not attacked at all by aqueous solutions of sodium chloride at any concentration or temperature under atmospheric pressure.

In its immunity to sodium chloride, tantalum does not depend upon the stability of any insoluble chloride film. Mixtures of other substances of an acidic nature with sodium chloride rarely have any effect upon tantalum, although solutions containing fluorides or substances which hydrolyze to alkalis may attack tantalum. Tests should be made if the presence of any such substance is suspected.

Tantalum is recommended as a material for heat exchangers, heaters, coolers or condensers in operations, pharmaceutical or C.P. preparations for example, where there must be no contamination of product due to metallic corrosion. It is also recommended for other sodium chloride operations where corrosion is so severe that the alloys usually employed cannot be used.

The destructive effects of sodium chloride solutions are greatly increased by the presence of free chlorine in solution. This condition is usually found in chlorine-alkali cells and associated equipment where heated brine containing free chlorine becomes sufficiently destructive to constitute a corrosion problem of real magnitude in brine coolers. A tantalum brine cooler of the shell and tube type has been placed in service and promises to be an effective solution to this troublesome problem.

Bromine and iodine compounds in sodium chloride solutions are also destructive to many materials, but have no effect whatever on tantalum. Tantalum equipment is used regularly in the purification of bromine and iodine products from salt solutions.

FROM THE LOG OF EXPERIENCE

Dan Guilden, ENGINEER

FOOD PACKAGING got its start towards its present state of perfection through the urge to improve the quality and the cost of the universal breakfast beverage that associates with the great American doughnut. Coffee beans were stocked by the country grocer, both green and roasted, in large burlap bags from which he drew into the common weighing scoop according to orders from the customer. The same scoop was used for every purpose and got an occasional scouring by a charge of nails or wire fence staples. However, the "store keeper" usually avoided promiscuous contact with the bare scoop by the intervention of a paper wrapper. The big, soil-absorbent jute or burlap coffee bags rested on the floor and, along with the sugar and cracker barrel, served as lounges for the political philosophers. The evolution from the barrel to the sanitary factory-sealed paper bag is an interesting tale and at the very beginning of it there stands the name of John Arbuckle, one of the robust characters in American merchandising.

ARBUCKLE'S IDEA was that marketing coffee beans in the green state was wasteful both as to material and quality. Around 1865 he proceeded to develop equipment that roasted the beans in suspension in heated air in order to avoid the deleterious local scorching by contact with hot metal. This imparted a superior flavor and, to retain this flavor, he glazed the beans with egg white and then packed them while warm in tight paper bags. His competitors derisively called them "little bags of peanuts." However, the packages and the aroma pleased the housewives and "Arbuckle's Ariosa Coffee" became known in every state in the union. By 1890 the demand for packages had grown so great as to make hand operation unwieldy. Arbuckle sought to improve his capacity and price position by mechanizing the operation. Furthermore the pure foods agitation emphasized the advertising value of the slogan "untouched by human hands."

AN AUTOMATIC packaging machine had been built in 1889 by one Henry E. Smyser for a Philadelphia tobacconist to fill small cotton bags with tobacco. Arbuckle sent Manager Gilmore to Philadelphia to investigate. This resulted in the purchase of the patent rights as respects food packaging and the transfer of Smyser to Brooklyn. Arbuckle provided a generous stipend and a spacious and well equipped machine shop on his property at the coffee plant. He furnished a staff of skilled artisans to do Smyser's bidding in order to free the master mind for the development of his wizardry. Arbuckle's only stipulation was that his bags were to be of paper to maintain the design which through the years had attained favor in the eyes of the housewives.

UNDER THESE favorable circumstances Smyser proceeded patiently through the vicissitudes of discouragement and elation. Eventually he arrived at the stage where the machine filled and closed an occasional bag successfully and then reverted to failure. He became greatly depressed and told Arbuckle that he could not build a mechanical filler. It was useless to continue. Arbuckle replied that if the machine filled one bag successfully, it was a good machine. The failure to repeat was the fault of the designer.

THE PERPLEXITY that harassed Smyser most was the appliance that conveyed the glue from the glue plate to the paper. This device was analogous to an arm having fingers which alternately made contact with the plate (upon which a film of glue was spread) and the stack of paper sheets destined for the folding machine. As the arm lifted upward, one sheet adhered to the fingers and was delivered by an appropriate movement to the folder. The folding apparatus then clasped the sheet while the fingers pulled away, leaving a daub of glue along the lines where it was needed for cementing after the paper had been folded over a form.

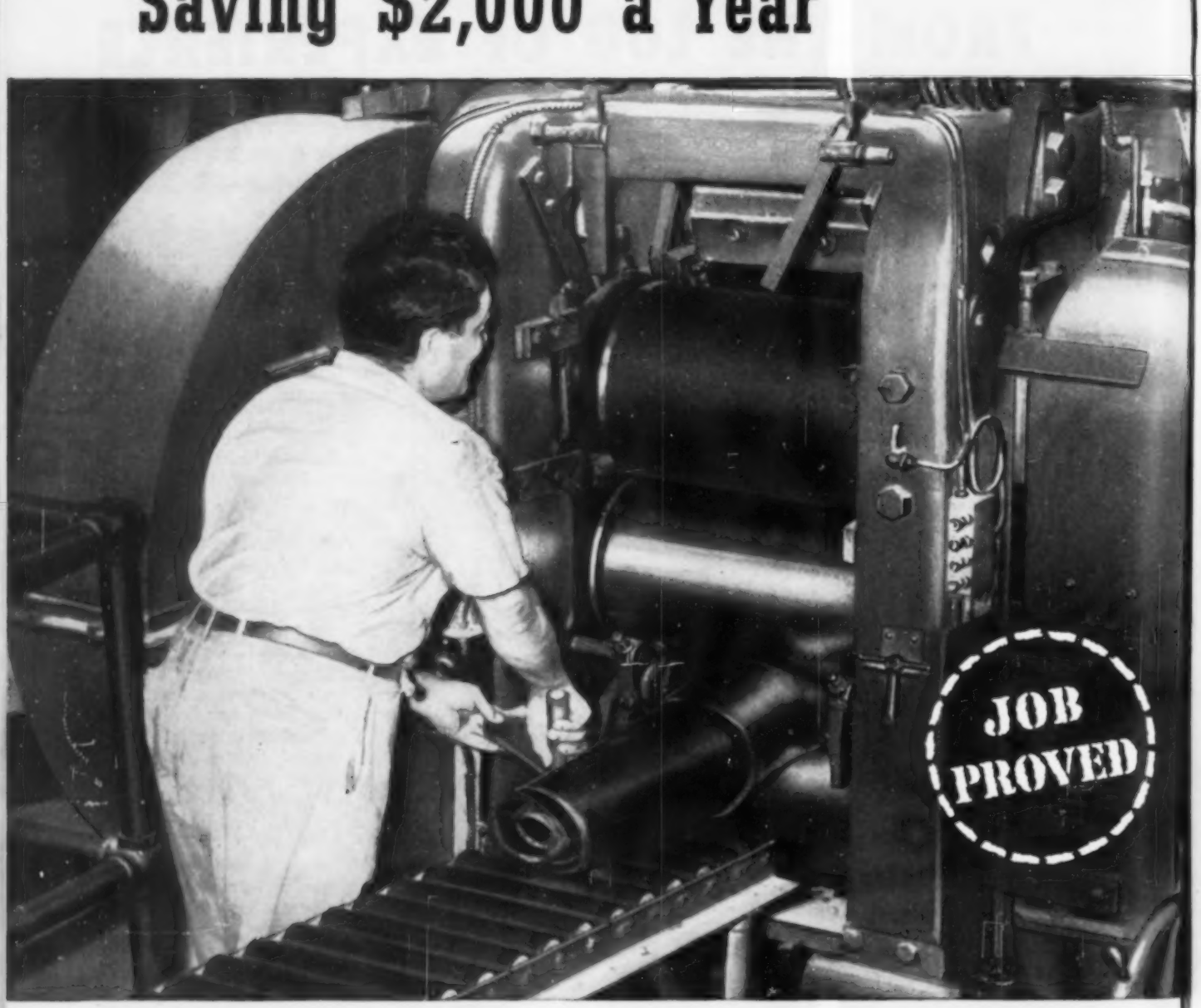
The fingers on the return trip invariably trailed a thread of glue that spread like cobwebs over the machine. Day after day Smyser sat at his desk testing glues of every quality and from every source. He painted a spot on his desk with glue and hour after hour he sat there wigwagging his index finger up and down from the spot. Always when he lifted his finger a string of glue followed. He could not get a clear break because of the viscous nature of the glue. The practice of alternately touching the glue-painted spot and lifting continued interminably.

One day, with his head humped low on the desk so as to bring his trial-and-error operation within his line of sight, his mind was rigidly absorbed as usual in the exasperating behavior of the stalactite which inevitably adhered to his seesawing finger. At one split second when his finger touched the glue, Manager Gilmore burst through the door. The sudden creak startled Smyser and his finger came up reflexively with a jerk, while his head turned to the door. After the interruption his eyes returned to his task and lo! the stalactite was absent! He repeated the jerk and then let out a terrific yell. "*I've got it! I've got it!*" Then for Gilmore's benefit he continued the performance with his finger jumping up from the glue with a jerk and each time the glue broke clean and there were no strings. The instantaneous timing of his finger on the glue with Gilmore's indiscreet entrance at the door had brought the solution to Smyser's mind.

PERFECTION was eventually achieved. The success of coffee packaging suggested buying sugar in bulk and marketing it in 2- and 5-lb. paper bags. The wide-flung Arbuckle merchandizers developed sales to voluminous and profitable proportions. The machines, built under the instinct of a blacksmith, were rugged and effective and, moreover, Smyser built a scale of amazing accuracy.

THE ORIGINAL PACKAGE had two colors while Arbuckle wanted three, namely, black, red and yellow. General Hoe had never built a press that printed more than two colors and said that further multiplications would be impracticable. Arbuckle insisted that if a machine could be made for

Saving $2,000 a Year



SUNDEX RUBBER PROCESSING AID...

Gives Greater Strength and Wear-Resistance to GR-S Stocks for Heavy Footwear

A manufacturer of heavy rubber footwear recently tested samples of GR-S rubber made with Sundex 53, and samples made with three other products, including his regular processing aid. In every case the rubber that had been plasticized and softened with the Sun product had better tensile strength and gave better results in elongation and abrasion tests.

A saving of $2,000 a year was effected in this plant as a result of changing to Sundex 53 — a higher quality product that costs less.

Sundex 53 is clean, uniform and easy to handle. It can be used in making various colored rubbers (other than white) without causing discoloration.

For practically every type of rubber there is a Sun processing aid that will speed up manufacture and improve quality. They do not cause surface bloom even in exacting products like chemically-blown sponge rubber, white sidewall tires and pastel-colored articles. For full information about Sun's "Job Proved" rubber processing aids, write Department CE-10

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two colors, it could also be made for three and thus his demand became the stimulus to the construction of the multicolored printing press. Arbuckle's annual requirement was over 100 million bags.

THE SMYSER MACHINE continued for years without competition to render efficient service. The label on the bag specified the quality and the weight. After the promulgation of Dr. Wiley's Pure Food & Drugs Act, Martin E. Goetzinger, business administrator of the Arbuckle industries, presented himself in Washington to secure Dr. Wiley's approval of the long-used label. Goetzinger declared that the quality concerned the health of the customer and he could therefore contemplate no tolerance short of perfection. One the other hand the weight is a physical thing that affects the customer's pocketbook. He thought the spirit of the law would be satisfied if the general average were correct so that there would be no consistent shortage nor a consistent overweight. He contended that the packaking of spices at $4 a pound demanded a greater degree of accuracy than was warranted, for instance, with sugar at 4½¢. Moreover, if the same degree of accuracy were required in weighing a barrel of sugar as is demanded for a one-ounce package of spice, the cost would rise and the customer's pocketbook would be adversely affected. Wiley felt some confusion and suggested that interpretation should be sought by way of the Supreme Court. Goetzinger, however, expressed an aversion to the Supreme Court getting between Wiley and himself. Wiley agreed to send inspectors to the Arbuckle plant to check the performance of the scales.

THE SCALE BUCKET was filled from a chute and when the bucket descended to the position of balance with the counterweight, the gate snapped shut. At that instant the bucket contained the desired weight exactly but this was subsequently increased by the amount of product in transit between the gate and the bucket. Adjustment was made by trial and error which was readily accomplished since the weight of the dribble during the closing of the gate was constant. The gross weight of the package included the specified weight of the coffee plus the weight of the bag plus the weight of the advertising circular including the premium list. The inspectors check-weighed many packages and were surprised at the constancy of the results. Once, however, they found a slight shortage. Immediately the machine was shut down and thoroughly inspected without disclosing any defects. It continued to weigh accurately. Then they did what they should have done first. They emptied the coffee from the underweight package and found it to weigh exactly one pound, but the tare was short. The feeding device that inserted the advertising circular had slipped in respect to one unit.

"ARBUCKLE'S ARIOSA COFFEE" appeared in an arch on the front of the package, as many an old timer will remember. Just below the angel trademark there was the legend "No Sediment—See Other Side." Wiley objected to the "No Sediment" on the ground that it was qualifying and it was illegal to add such a phrase in the position on the front of the package. Goetzinger therefore struck it off. Wiley admitted that "See Other Side" could not be objectionable in the case of coffee but it might provide a loophole. Straightway a stroke of Goetzinger's pen obliterated this.

ANY BAG filled at the factory has an advertising value which is lost when the grocer buys in bulk and fills his own. Arbuckle exploited this value by rewarding faithful customers. Evidence of custom was the "Arbuckle" signature cut from the emptied bag. A schedule enclosed in the bag listed the premiums available, with the number of signatures and amount of postage required for each.

In one year 108 million signatures were returned to Brooklyn and, in exchange, over 4 million premiums were distributed. The popular articles were handkerchiefs to the number of 820,000; lace curtains, 261,000 pairs; scissors, 239,000; wedding rings, 80,000 and Torey razors, 186,000. The heavy mail influenced the government's decision to build a new post office in Brooklyn. The export duty collected by the Brazilian Government on Arbuckle's coffee provided the funds to build an occasional battleship for that country.

The lace curtain premium required 60 signatures. The cotton market was rising and the orders overwhelmed the manufacturer and threatened him with disaster. He begged Arbuckle to recall the premium lists but, as they were distributed in bags all over the country, this was impossible. However, Arbuckle made some price improvement to assist the manufacturer in his plant enlargement. Subsequently the wide advertising through the Arbuckle premium list kept his plant at full production long after the curtains were taken off the list. The Torey Razor Company also built a new plant to execute the Arbuckle orders. The same blades furnished for the luxury trade were supplied but with plain handles and cases. An inclosure in the coffee packages that attracted unusual popularity was the geographic picture series. The kids traded duplicates to obtain complete sets. School teachers made so great a demand that it became necessary to print sets for sale. This job constituted the largest order for color lithographing that had ever been produced.

SMYSER'S BAG PACKER possessed all the elements of economic efficacy. It started with a roll of paper (as with a news print press) and then proceeded in one uninterrupted sequence to print, cut, form, fill and seal, and finally deliver the package ready for the market. Expediency may demand the separation of bag making and the filling operations. In that case the bag making specialist routes by way of containers to storage. Subsequently the bags are returned to the production line under benefit of an impulse that demands the use of an operative's head, which thereby adds cost. Furthermore whenever there is an interruption in an operation to delineate a specialty, proper business administration adds a percentage for overhead. The continuous packaging machine like the German Hesser, now used by the British sugar refiners and by large American food processors, employs a single production line that starts like a printing press with a roll of paper and ends with the package ready for the grocer's shelf.

LARGE CHAIN STORES recognized the merits of factory-sealed bags but some few "independents" continued to extract imaginary profit out of the residue in the bottom of a 100-lb. bulk bag after twenty 5-lb. packages had been packed out. Eventually public prejudice drove the hand-packed bag off the counters. "Untouched by human hands" as an advertising slogan became obsolete since the machine age had raised the price of a pair of hands to a dollar an hour. Furthermore the Pure Food law "compels people to state on the outside what's in the inside" both as to quality and weight. The old gag about sand ballasting sugar, which never had any factual basis, had its last fling in "Judge" in 1912, to wit:

> Little pounds of sugar,
> Mixed with grains of sand
> Make the grocer's bank roll
> Gradually expand.

Do you know both sides of this story?

TIMKEN 18-8 STEEL TUBES Shows the best combination of creep strength, oil corrosion resistance and oxidation resistance up to 1500°F.

TIMKEN SICROMO 9 M STEEL TUBES This steel possesses the maximum corrosion resistance of any of the steels below the stainless group.

TIMKEN SICROMO 7 STEEL TUBES For applications requiring better corrosion resistance than can be obtained with 5% Chromium type steels.

TIMKEN SICROMO 5 S STEEL TUBES For oxidation resistance to 1500°F. Good creep strength and corrosion resistance to 1300°F.

TIMKEN 4-6% CR MO STEEL TUBES For service up to 1200°F. Superior corrosion resistance. Less oxidation resistance than Sicromo 3.

TIMKEN SICROMO 3 STEEL TUBES For service up to 1200°F. Have excellent oxidation resistance and good corrosion resistance.

TIMKEN SICROMO 2 STEEL TUBES For service up to 1200°F. where better scale resistance is required than can be obtained with 2% Cr. ½% Mo. Steel.

TIMKEN 2¼% CR-1.0% MO STEEL TUBES For service up to 1150°F. Has greater resistance to creep than 2% Cr. ½% Mo. Steel.

TIMKEN 2% CR ½% MO STEEL TUBES For service up to 1150° F. Intermediate corrosion resistance plus good creep strength, fair oxidation resistance.

TIMKEN D M STEEL TUBES For service up to 1150°F. This steel offers outstanding creep strength.

TIMKEN CARBON-MO STEEL TUBES For temperature up to 1000°F. Improved creep strength makes it safer than carbon steel.

TIMKEN CARBON STEEL TUBES Generally for service not exceeding 900°F., where corrosion and oxidation resistance are not important.

WHETHER your toughest high temperature tube problem is corrosion, oxidation, heat or pressure, there's a Timken steel that was specially developed to meet it. These 12 Timken steels range from carbon to stainless, are recommended for service from 900° F. to 1500° F., and include the famous DM and Sicromo steels.

In addition to the advantage of wide selection, uniform quality in each lot of Timken alloy steels is assured. Every step of production—from melt shop through final tube inspection—is closely and completely controlled by The Timken Roller Bearing Company within our own plants.

Which "Personality"?

Yes, The Timken Company makes a high quality alloy steel to fit every high temperature tube need—but that's only half the story! Selecting the *one* steel which best fits *your* special needs is important too! Because each analysis has its own "personality"—a unique combination of physical properties—only one will give you maximum tube life per dollar invested for a particular application.

Picking the right "personality" is a job for specialists—like the Timken Company's metallurgists. Eighteen years' experience and research have made them the recognized authorities on high temperature applications.

Here's Valuable Help

No other steel producer can offer you this combination of experience, research and complete quality control. Why not let our Technical Staff make specific recommendations on *your* high temperature tube problems? Write Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

NAMES IN THE NEWS

W. M. Lee

C. W. Balke

B. J. C. van der Hoeven

William M. Lee has joined the research and development department of the Pennsylvania Salt Manufacturing Co. as supervisor of the special products division. He was formerly chief of the chemicals and plastics section of the office of the Quartermaster General. In this position he planned, coordinated and expedited research and development work on insecticides, special fuels, detergents, protective coatings, molded plastics, coated fabrics and high tensile strength laminates and other war-important materials.

Cristie J. Geankoplis and **Gordon MacBeth** have been appointed instructor and assistant instructor respectively, in chemical engineering at the University of Pennsylvania.

Collins Thompson, Jr., formerly in the engineering department of Du Pont, is now with the nylon division in sales development in the field of nylon application for industrial fabrics.

W. Albert Noyes, Jr., head of the department of chemistry in the University of Rochester, has been named chairman of the division of chemistry and chemical technology of the National Research Council.

William H. Schnabel, formerly superintendent of the acetic acid unit at Bishop, Tex., plant of Celanese Corp. of America, has been transferred to the New York office as director of the new technical service department of Celanese.

Clarence W. Balke of the Fansteel Metallurgical Corp., has been announced as the recipient of the Perkin Medal for 1948. Presentation will take place at a meeting in New York on January 7. The award is made annually for outstanding work in applied chemistry and is being given to Dr. Balke for his methods for production of tantalum and columbium and his contributions to ferrous powder metallurgy.

Robert S. Aries has been appointed adjunct professor of chemical engineering at the Polytechnic Institute of Brooklyn. Dr. Aries was previously research associate of the Polytechnic Institute and director of the Northeastern Wood Utilization Council, a position which he will continue to occupy.

George N. Hoover, Jr., and **Ray A. Stocker** have been named assistant managers of the Mechanicville, N. Y., plant of West Virginia Pulp and Paper Co.; **Melvin L. McCreary** has been advanced to assistant manager of the Williamsburg, Pa., plant, and **J. Lynne Ferner** has been promoted to general superintendent of the Tyrone, Pa., plant.

Nelson Francis Murphy, until recently director of engineering and development work for the penicillin manufacturing plant of Bristol Laboratories, at Syracuse, N. Y., has been appointed to the new position of research professor of chemical engineering at Virginia Polytechnic Institute, Blacksburg.

B. J. C. van der Hoeven has been appointed assistant general manager of the chemical division of Koppers Co. The position is a newly created one in the expanding chemical division. During the war Mr. van der Hoeven was manager of operations of the Kobuta, Pa., styrene and butadiene plant which was built and operated by Koppers for the government. Since early last year, he has been chief of the company's chemical engineering department, engineering and construction division.

Glenn T. Seaborg of the University of California, has ben awarded the William H. Nicols Medal of the New York Section of the American Chemical Society for 1948. The medal, to be presented in New York March 8, goes to Prof. Seaborg for his research on plutonium, participation in the discovery of americium and curium and many artificial radioactive materials.

L. A. Thompson has been recently transferred from Marrero, La., to Atlanta, Ga., where he will continue with Hercules Powder Co. as manager of the southern district, paper makers chemical department. He will make headquarters at 415 Rhodes-Haverty Building.

Shirley E. Meserve, formerly vice president and general counsel, has been elected president of the Fluor Corp., Ltd., Los Angeles. **W. Earl Dunn**, formerly vice president and general manager, will now serve as executive vice-president. Dunn is succeeded in his

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100% AUTOMATIC

APPROVED BY UNDERWRITERS' LABORATORIES

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THE LIQUIDOMETER CORP.
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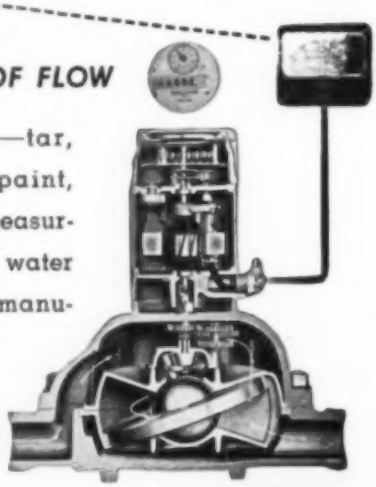
NEW

HAYS Veriflow TOTALIZING-INDICATING METER

Featuring
REMOTE INDICATION OF RATE OF FLOW



For practically all liquids—tar, molasses, crude oil, grease, paint, varnish, syrups, etc., etc.—for measuring, indicating, totalizing flow of water and chemicals in continuous manufacturing processes and numerous other uses. Its remote indicating feature is new—get the complete story.

SEND FOR BULLETIN 46-766

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

former capacity by **D. W. Darnell**, formerly vice president and chief engineer.

Robert A. Ewing has joined the staff of Battelle Institute, Columbus, Ohio, where he will be engaged in research in chemical engineering.

L. F. Eiklor has been appointed general manager of the Harshaw scientific division of the Harshaw Chemical Co. in charge of all the division's activities both at the main office in Cleveland and in the various branches.

L. V. Burton

Laurence V. Burton has been appointed executive director of the Packaging Institute, New York, to succeed **Albin Dearing** who has resigned. Dr. Burton has been editor of the McGraw-Hill magazine, *Food Industries*, for the past 17 years and has been a member of its editorial staff since it was started in 1928.

C. M. Suter, identified with the research activities of Sterling Drug since 1942, has been elected divisional vice president of the Sterling-Winthrop Research Institute, Rensselaer, N. Y.

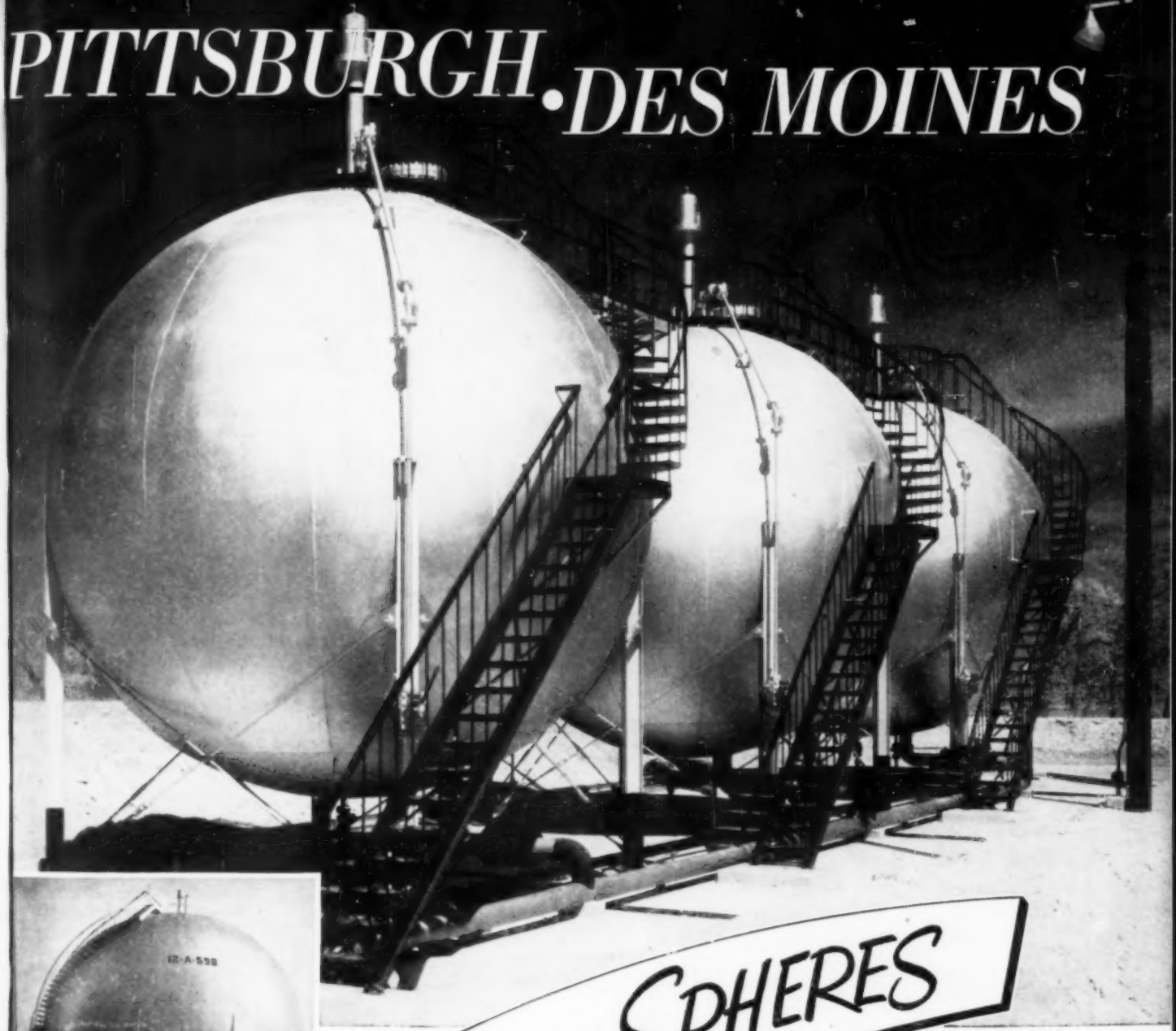
William M. Newton has been appointed professor in the department of chemical engineering at Georgia Tech.

A. B. Kinzel, vice president of the Union Carbide and Carbon research laboratories, has been re-elected chairman of the Engineering Foundation.

David N. Burruss, Jr., has been appointed to the position of director of engineering for the Glidden Co., Cleveland.

Joseph J. Mattiello, vice president and technical director of the Hilo Varnish Corp., Brooklyn, has been made Chevalier of the Legion of Honor of France. The award was made to Dr.

PITTSBURGH • DES MOINES



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DESIGNED AND BUILT FOR THE STORAGE OF LIQUIDS AND GASES UNDER PRESSURE....

Provide better service and economy

Thoroughly researched, skillfully engineered and painstakingly fabricated, Pittsburgh-Des Moines Steel Spheres meet every performance requirement for pressure storage of your volatile liquids or gases—with definite economy benefits in operation. A consultation on your storage problems can develop pertinent, helpful facts toward their solution. *Let us cooperate with you!*

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CHICAGO, 1207 First National Bank Bldg.
DES MOINES . 916 Tuttle Street
DALLAS . 1216 Praetorian Bldg.
SEATTLE, 507 First Ave., South
SANTA CLARA, CAL. . . . 606 Alviso Road

Get 3-Way Savings

with TRANSITE PIPE for Industrial Water Lines

Searching for *sound* economies, many plant engineers have found they can effect these 3 important water line savings by using Transite Pipe:

1. Installation. You save with Transite because this asbestos-cement pipe is light in weight, easier to handle and install. The Simplex Couplings form tight, flexible joints that are quickly assembled in the trench even by inexperienced crews.

2. Operation. Transite Pipe has an initial high flow rate of C-140 that can never be reduced by tuberculation, the costly internal corrosion which chokes off carrying capacity. Transite's *maintained* high carrying capacity helps keep pumping costs low!

3. Maintenance. Transite Pipe is strong and durable. Made of asbestos and cement combined under great pressure into a tough, dense, homogeneous structure, this pipe resists corrosion *inside, outside,* and *all the way through.* Year after year, Transite Pipe provides efficient and economical service for water supply lines, fire lines and process lines of many types.

Get all the facts on the many advantages of Transite Pipe by writing to Johns-Manville, Box 290, New York 16, N. Y. Ask for the Transite Pressure Pipe brochure.

JM

Johns-Manville

TRANSITE PRESSURE PIPE

for Water Supply Lines • for Fire Lines • for Process Lines

Mattiello in recognition of services in World Wars I and II as well as his contributions to science.

Donald G. Zink, formerly director of technical development of U. S. Industrial Chemicals, has joined the staff of Stanolind Oil and Gas Co., Tulsa, Okla., as superintendent, chemical products department.

Paul O. Powers, technical advisor of the Battelle Memorial Institute, Columbus, Ohio, has been elected chairman of the division of paint, varnish, and plastics chemistry of the American Chemical Society. He succeeds the late **Earl McMullen** of the Eagle-Picher Lead Co., Joplin, Mo.

Harry E. Outcault, assistant sales manager of the St. Joseph Lead Co., New York, has been elected chairman of the division of rubber chemistry of the American Chemical Society. He succeeds **W. W. Vogt,** development manager of the Goodyear Tire and Rubber Co., Akron, Ohio.

Robert S. Long has been appointed an assistant director of the organic section of the research department of Calco chemical division, American Cyanamid Co.

Charles R. Fordyce, superintendent of the manufacturing experiments department of the Eastman Kodak Co., Rochester, N. Y., has been elected chairman of the division of cellulose chemistry of the American Chemical Society. Dr. Fordyce succeeds **Milton Harris,** head of the Harris Research Laboratories, Washington, D. C.

Virginia Blair has transferred from Memorial Hospital, New York, to Southern Research Institute, Birmingham, Ala., where she will continue research work in organic chemistry.

C. G. Bensinger, formerly vice president and general factories manager of the glass container division of Owens-Illinois Glass Co., Toledo, has been selected as vice president and general manager of the Pacific Coast division with headquarters in San Francisco.

A. J. R. Curtis, safety director of the Portland Cement Association has been awarded the Joseph A. Holmes medal of honor for his contributions to safety in the cement industry. Mr. Curtis is only the second individual to receive this medal.

James H. Lum, former executive director for Monsanto at Clinton Laboratories, Oak Ridge, Tenn., has left for Melbourne, Australia, to become man-

NOW! STACK HEAVIEST LOADS TO 124 INCHES
2-4 TON LOADS TO NEW HEIGHTS

With Automatic's Amazing NEW Heavy Duty

Skylift BRAWNY

Tiers 5 inches higher than any other fork truck of like capacity

Now, for the first time, amazing new Skylift BRAWNY lifts loads of 4,000 to 8,000 pounds to *heights never before attained* in heavy-duty fork trucks of like capacity. Yet, it also tiers to ceiling heights in boxcars and low-clearance buildings, is smaller, lighter, compact!

With a collapsed height of 83 inches (pass through standard 7 foot door), the 4, 5 and 6,000 pound BRAWNYS lift to 124 inches—the 7 and 8,000 pound models to 115 inches.

Skylift BRAWNY'S hydraulic lift telescopic action, is engineered so that the forks and uprights are raised independently by separate rams. The forks thus raise to 62½ inches (59½ for 7 and 8,000 pound models) before the uprights begin to extend. So you stack to new heights, yet tier in low ceiling buildings.

NEWmatic Controller makes the Skylift BRAWNY easier to handle than any similar sized truck. It eliminates tire slippage. When acceleration is applied, the NEWmatic starts truck in first speed and automatically passes through faster speeds. Thus you get extra safety and economy—truck can be started in forward or reverse only when in low speed or neutral.

Let an ATCO Specialist show you how much this amazing new Skylift BRAWNY can *cut your material handling costs*—give you *floor-to-ceiling, extra free storage space.* Mail the coupon today!

Yet move, lift and stack material in low ceiling buildings!

Be Sure to Attend Jan. 12-16

2ND NATIONAL MATERIALS HANDLING EXPOSITION
CLEVELAND AUDITORIUM
JANUARY 12-16 1948

LOOK TO THE LEADER FOR ALL THAT'S NEW!

Skylift BRAWNY
A PRODUCT OF AUTOMATIC
Lightens LIFE'S LOADS

MANUFACTURERS OF THE FAMOUS TRANSPORTERS, TRANSTACKERS AND SKYLIFT ELECTRIC TRUCKS

AUTOMATIC TRANSPORTATION COMPANY
DIV. OF THE YALE & TOWNE MFG. CO.
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Please mail me, without cost, complete facts on your new Skylift BRAWNY Electric Truck.

☐ Have an ATCO Specialist make a free survey of my material handling costs.

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By.....*Position*.....

Street Address.....

City.....*Zone*.....*State*.....

Presenting the New

BOWSER
STAINLESS STEEL METER

. . . for any liquid that can be handled with STAINLESS STEEL

A new 1½-inch, 50 g.p.m. Bowser stainless steel meter has been developed for the measurement of liquids that cannot be handled successfully by conventional meters. In design and operating principle it is basically the same as the widely used Bowser Industrial Xacto meter. It has flanged connections and is suitable for working pressures up to 250 p.s.i.

BOWSER, INC.
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BOWSER ESTABLISHED 1885

LIQUID CONTROL SPECIALISTS SINCE 1885

aging director of Monsanto (Australia) Pty. Ltd. The company has plants at Melbourne and Brisbane.

F. R. Eirich of Cambridge University, England, has been appointed assistant professor of colloid chemistry at the Polytechnic Institute of Brooklyn.

Robert K. Prince has been named manager of the wood processing machinery section of the Allis Chalmers basic industries department.

Edwin S. Worden, Jr., has been added to the staff of Container Laboratories, as research executive.

Robert Thomas has joined the research laboratory staff of Michigan Chemical Corp., St. Louis, Mich., in charge of organic research. He was formerly with the Firestone research laboratories at Akron.

Thomas P. May has joined the corrosion engineering section of the development and research division of the International Nickel Co. at New York Dr. May was formerly with the U. S Naval Research laboratory.

OBITUARIES

Stephen Miall, the well-known former editor of our British contemporary *Chemistry and Industry*, died October 12.

Francis C. Krauskopf, 69, professor of chemistry at the University of Wisconsin, died in Madison October 16.

William H. Hoodless, 70, vice president in charge of development and design of the National Sugar Co., died in Philadelphia October 20.

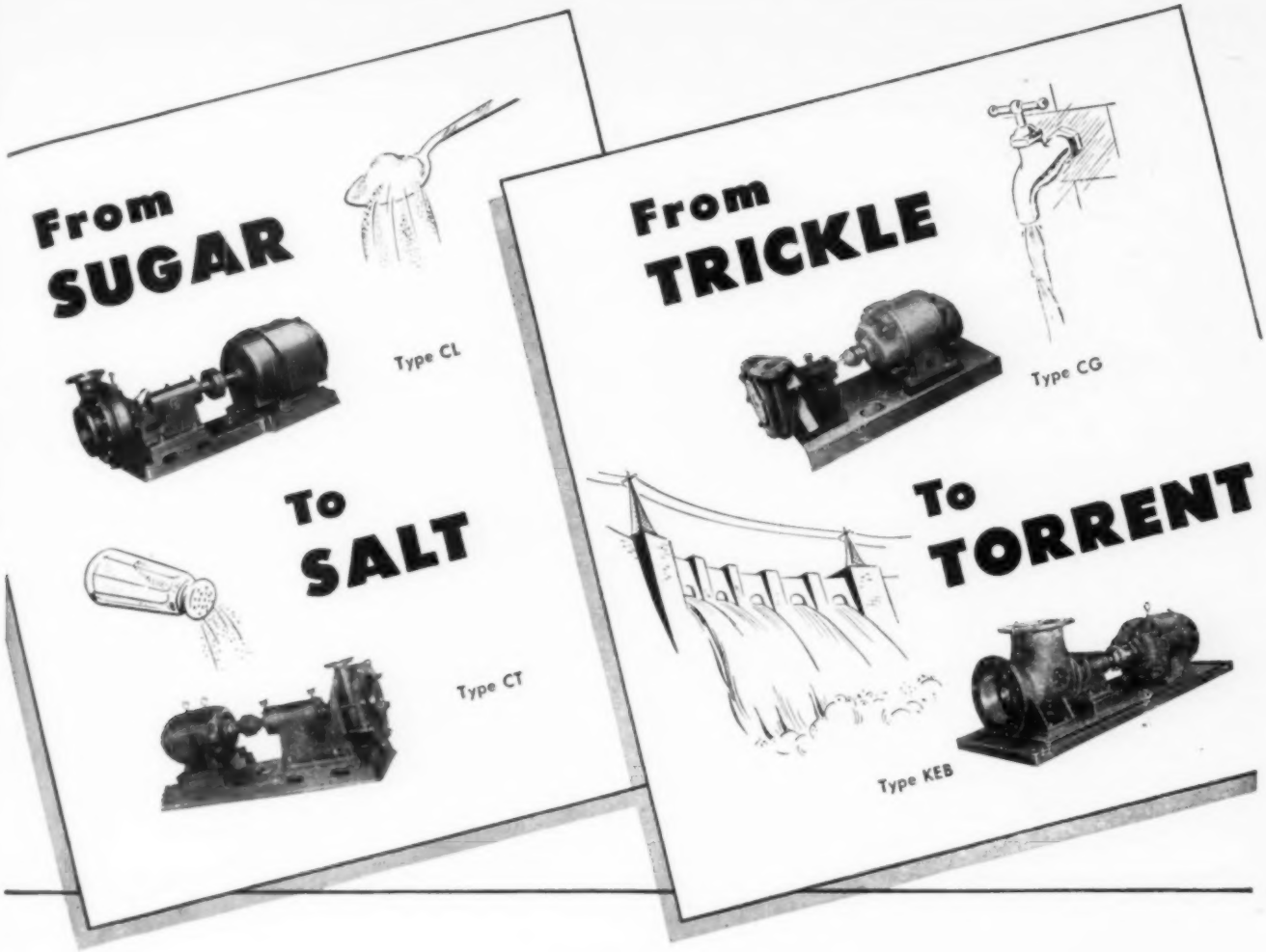
Ernest Blaker, 77, formerly with the B. F. Goodrich Co., died in Akron October 20.

Herbert R. Moody, 77, a former chairman of the division of chemistry and chemical technology of the National Research Council died at his home in Vienna, Va., October 20.

Howard S. Neiman, 79, patent attorney and honorary secretary of the American Institute of Chemists, died in Brooklyn October 31.

Edwin M. Allen, 75, former chairman of the board and former president of the Mathieson Alkali Works, died at his home in Rye, N. Y., November 2.

Saul Cromwell, 79, former official of the Foster Wheeler Corp. and of Westvaco Chlorine Products Corp., died in Woodbridge, N. J., November 3.



Worthington Standard Centrifugal Pumps serve all processing industries

Whether your pumping problems involve corrosion, abrasion or contamination, or are strictly hydraulic, you'll find efficient, economical, *ready-made* answers in Worthington Centrifugal Pumps.

"Across the Board" in Chemicals

Worthington Worthite Pumps, for example, are something extra-special in stainless steel alloys. Developed to handle the widest range of pump-punishing liquids, they are equally resistant to corrosive, low pH sugar syrups and corrosive-abrasive brine slurries at the boiling point.

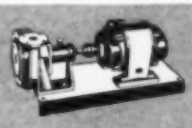
As for Capacities . . .

Worthington Centrifugal Pumps deliver from 5 to 18,000 gpm, smoothly and steadily at all usual heads and speeds. In short, to all industrial processing—from paper to plastics, from rayon to rubber—Worthington offers more pumps for more jobs, plus the longest experience in the field. For details proving *there's more worth in Worthington*, contact our nearest District Office or *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

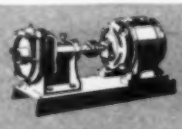
WORTHINGTON

C7-7

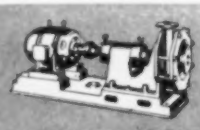
THE WORLD'S LARGEST MANUFACTURER OF PUMPS



Types CO and COL. Sizes ¾" to 10". Capacities to 5000 GPM; heads to 200 ft. Liquid ends of WORTHITE alloy.

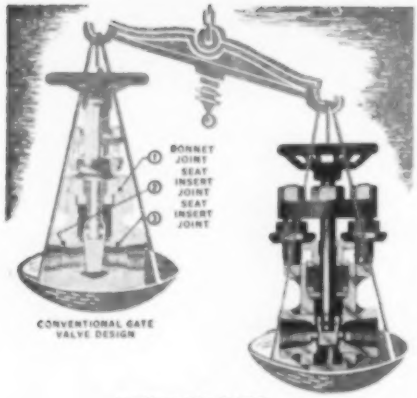


Type CF. Sizes 1" to 4". Capacities to 1000 GPM; heads to 130 ft. Standard, all iron and all bronze.



Type CQ. Sizes 1½" to 3". Capacities to 600 GPM; heads to 130 ft. at 1750 RPM. Closed impeller. WORTHITE shaft and fittings.

Type L. Sizes 3" to 8". Capacities to 2250 GPM; heads to 300 ft. Single stage volute. For general service.



HANCOCK GATE WELDVALVE

Count the joints!

EACH of the three joints in the conventional gate valve design shown at the left above is a potential source of leakage. *There are no joints in the* Hancock WELDVALVE!

There is no bonnet joint in the Hancock WELDVALVE, because it has no bonnet.

There are no seat insert joints, because the super-hard cobalt-chromium faced seats are integral with the valve body and never need to be replaced. Excess handwheel pressure to align distorted seating surfaces is not necessary for WELDVALVE tightness, because the alignment of the angle of the seats with the "500 Brinell" stainless steel wedge is finished to *exact* dimensions before assembly.

Designed for 800# at 750°F or 2000# at 100°F. Sizes ¼" to 2" inclusive.

Stocked and sold by leading Distributors everywhere. Write them or us for details.

HANCOCK *Valves*

A Product of

MANNING, MAXWELL & MOORE, INC.

WATERTOWN 72, MASSACHUSETTS

Makers of Hancock Valves, Ashcroft Gauges, Consolidated Safety and Relief Valves and American Industrial Instruments

INDUSTRIAL NOTES

Lion Oil Co., El Dorado, Ark., has elected T. H. Barton chairman of the board. R. M. Martin, executive vice president succeeds him as president.

E. I. du Pont de Nemours & Co., Inc., Wilmington, has appointed E. Hearn Simpson to the new position of assistant sales manager of petroleum additives. Barry V. Cornwall succeeds him as sales manager for the alcohol and camphor section.

Enjay Co. Inc., New York, has opened its new home office in the Esso Bldg. at 15 West 51 St.

Borg-Warner Corp., Chicago, has appointed E. W. Deck manager of the Ithaca plant of the Morse Chain Co.

Koppers Co., Pittsburgh, has arranged to acquire the Manufacturers Chemical Corp., Berkeley Heights, N. J.

Link-Belt Co., Chicago, has established a sales office in Grand Rapids, Mich. Peter Groustra is manager.

Pittsburgh Plate Glass Co., Pittsburgh, has appointed Thomas G. Wright assistant to the general superintendent of plate glass factories.

Ferro Enamel Corp., Cleveland, has announced C. D. Clawson, president, was named president of the Porcelain Enamel Institute.

Allied Chemical & Dye Corp., New York, has renamed three of its subsidiaries. Solvay Process Co. becomes the Solvay Process division. Solvay Sales Corp. is now Solvay Sales division and General Chemical Co. becomes the General Chemical division of the parent company. There were no changes in personnel.

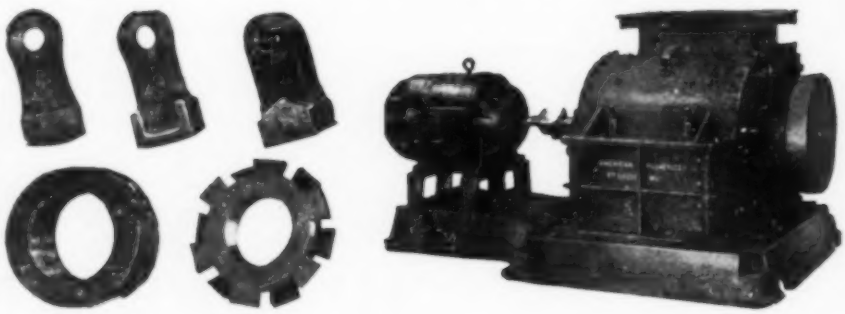
Houdry Process Corp., Philadelphia, has appointed Dr. Alex G. Oblad and Jack C. Dart director of chemical research and director of development, respectively at the Houdry Laboratories.

Bemis Bro. Bag Co., St. Louis, has purchased a 15-acre site in Hopkins, near Minneapolis, for additional plant construction. W. J. Geimer will manage the new plant.

United States Rubber Co., New York, has formed a staff to operate the synthetic rubber plant in Borger, Tex. George A. Graham is factory manager and J. Warren Braley production su-

Get Greater CRUSHING CONTROL with

AMERICAN Hammermills



In the chemical field, more than any other—control is necessary in crushing. For this reason American Hammermills, including the 24 Series Crusher shown above, are favorites. They provide great flexibility for crushing a wide range of friable and fibrous materials of various hardnesses and hydroscopy. The rugged, balanced rotor can be equipped with rolling rings, shredder rings, or any of three types of hammers for custom-made reducing action. Convenient external controls make for easy individual size control over a wide range of reduction. Capacities to 50 TPH, others up to 500 TPH.

Write about your crushing problems or send samples of material.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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"PITTSBURGH"

...a dependable source — for

COAL CHEMICALS

Complete integration of its manufacturing facilities plus economical water borne supply of its own principal raw materials, make *Pittsburgh* Coke & Chemical Company a reliable source of supply for Coal Chemicals and associated products. Inquiries for any of the products listed below are invited and, for special applications, technical assistance and recommendations are available for the asking.

COAL CHEMICALS

AROMATIC HYDROCARBONS:
BENZOL, TOLUOL, XYLOL, NAPHTHALENE
TAR ACIDS: PHENOL, CRESOLS
PARA AMINO PHENYL MERCURIC ACETATE
SULPHURIC ACID: ALL GRADES
TAR, PITCH and CREOSOTE
SULPHATE OF AMMONIA
TAR BASES: PYRIDINE, PICOLINES
ALKYL METHYL PYRIDINIUM CHLORIDE
SODIUM CYANIDE · SODIUM THIOCYANATE
PHTHALIC ANHYDRIDE
ACTIVATED CARBONS

OTHER PRODUCTS:
PIG IRON—NEVILLE COKE—EMERALD COAL—
GREEN BAG CEMENTS—CONCRETE PRODUCTS—
LIMESTONE PRODUCTS

CHEMICAL SALES DIVISION

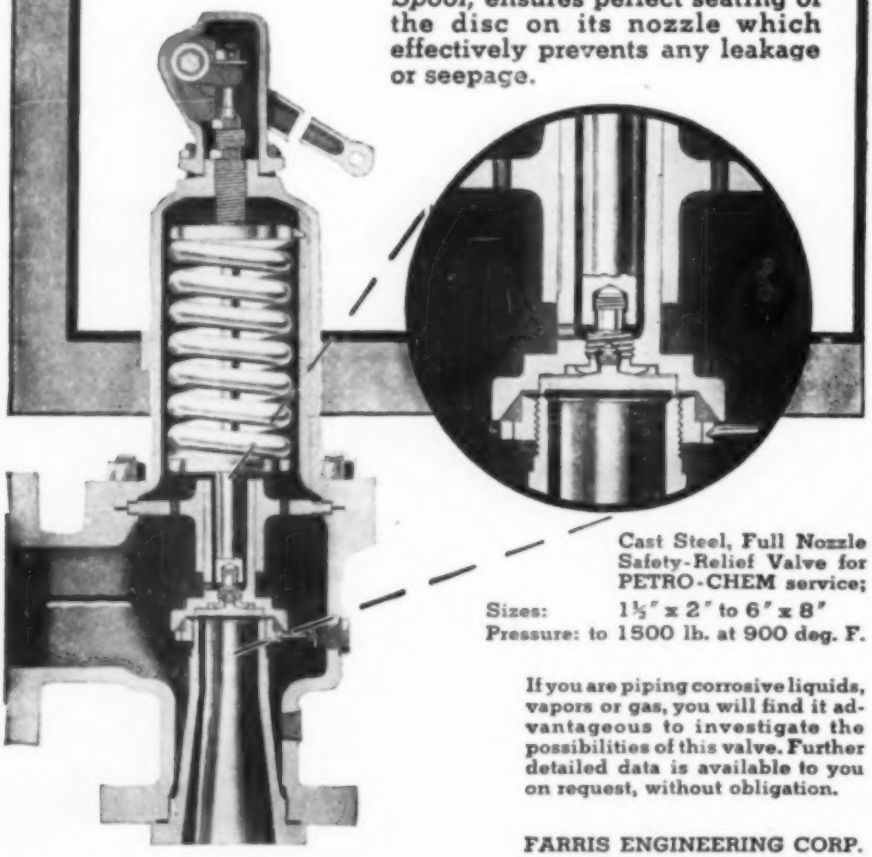
Pittsburgh Coke & Chemical Company

Grant Building · Pittsburgh 19, Pennsylvania

CERTIFIED CAPACITY ★
CERTIFIED CONSTRUCTION
FARRIS SAFETY-RELIEF VALVES

★ Certified capacity—by actual test at The National Board of Boiler and Pressure Vessel Inspectors Laboratories . . . your warranty that this valve has the specified relieving capacity . . . your assurance of complete protection for the equipment served.

- Certified construction . . . your assurance of structural soundness and design for specified pressure.
- 2½ to 1 guide ratio of the disc guide assures full lift and positive reseating.
- Combination of nozzle and inverted cone or secondary nozzle makes maximum use of the kinetic energy of the discharge to effect high lift and full capacity.
- Floating disc, operating through an *Alignment Spool*, ensures perfect seating of the disc on its nozzle which effectively prevents any leakage or seepage.



Cast Steel, Full Nozzle Safety-Relief Valve for PETRO-CHEM service;
Sizes: 1½″ x 2″ to 6″ x 8″
Pressure: to 1500 lb. at 900 deg. F.

If you are piping corrosive liquids, vapors or gas, you will find it advantageous to investigate the possibilities of this valve. Further detailed data is available to you on request, without obligation.

FARRIS ENGINEERING CORP.
404 Commercial Ave.
Palisades Park, N. J.

Farris

SAFETY and RELIEF VALVES

FARRIS keeps pace with advancing power and process engineering

perintendent. Carl W. Walden is chief chemist.

American Machine and Metals, Inc., East Moline, Ill., has appointed Frederic C. Weicker sales manager of the Tolhurst Centrifugals division.

Parker Appliance Co., Cleveland, has appointed Morman Belting and Supply Co., Milwaukee, distributor.

Hercules Powder Co., Wilmington, has appointed Fred K. Shankweiler manager of the cellulose products department office in New York. Clarence W. Gault succeeds him as manager of the Chicago office.

Hammel-Dahl Co., Providence, has appointed the Metrol Co., Detroit, Mich., sales representative for that area.

International Paper Co., New York, has opened a branch sales office in New Orleans. H. Currie is the manager.

Hewitt-Robins Inc., Passaic, N. J., has appointed the St. Louis Railway Supply Co., St. Louis, as a distributor of Robins Conveyors division.

Allis-Chalmers, Milwaukee, has named Robert K. Prince manager of the wood processing machinery section of the basic industries department.

Ferro Enamel Corp., Cleveland, has announced the opening of new offices at 336-338 North Central Ave., Chicago.

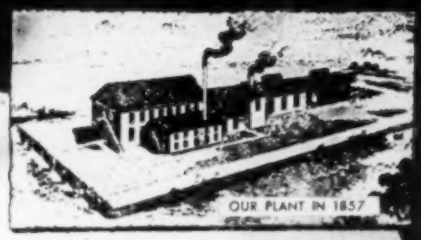
Upjohn Co., Kalamazoo, Mich., will open a new branch office and warehouse at 1001 East 87th St., Chicago, in January. John W. Schma will be sales manager and Fred O. Chapman office manager.

Monsanto Chemical Co., St. Louis, has appointed Milton Welhoelter assistant manager of the design section of the general engineering department. Robert E. Wright has been named assistant to the section manager.

Patterson Foundry & Machine Co., East Liverpool, Ohio, has made Raymond H. Jebens chief chemical engineer.

Republic Filters, Inc., Newark, N. J., has appointed Francis X. Dealy vice president in charge of sales.

Fairbanks-Morse & Co., Chicago, has transferred J. C. Elmburg to Atlanta as manager of that area. V. O. Harkness will manage the Boston



GROWING OLD

isn't something new, but . . .

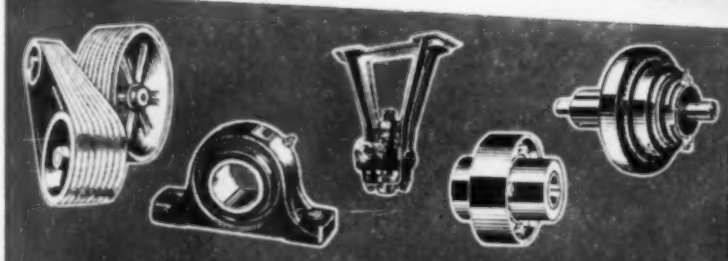
the experience and knowledge of industry's needs accrued over more than 90 years of constant growth and progress in one business — under the management of the founder's family — is, we believe, unusual.

The T. B. Wood's Sons Company was founded in 1857 as a small, unpretentious iron foundry. Since that time, it has grown steadily, until today, it serves all industry with a Quality Line of Power Transmission Equipment — designed with sound engineering principles and produced of the best materials by proven manufacturing methods.

Now, that we might serve industry still better, we have enlarged and improved our foundry, machine shop and other facilities. An attractive, profusely illustrated brochure describes our facilities and increased capacity — fill in the attached coupon — we'll mail your copy promptly.

PULLEYS • CLUTCHES • HANGERS
PILLOW BLOCKS • COUPLINGS
BEARINGS • COLLARS • V-BELT
SHEAVES AND COMPLETE DRIVES

T. B. Wood's SONS COMPANY CHAMBERSBURG, PA.



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BRANCHES: BOSTON, MASS. NEWARK, N. J. PITTSBURGH, PA. CLEVELAND, OHIO DETROIT, MICH.

MARTIN CALCINER / PREHEATER

PROVIDES FOR RABBLING MATERIAL IN ATMOSPHERE TEMPERATURE UP TO 2500°F

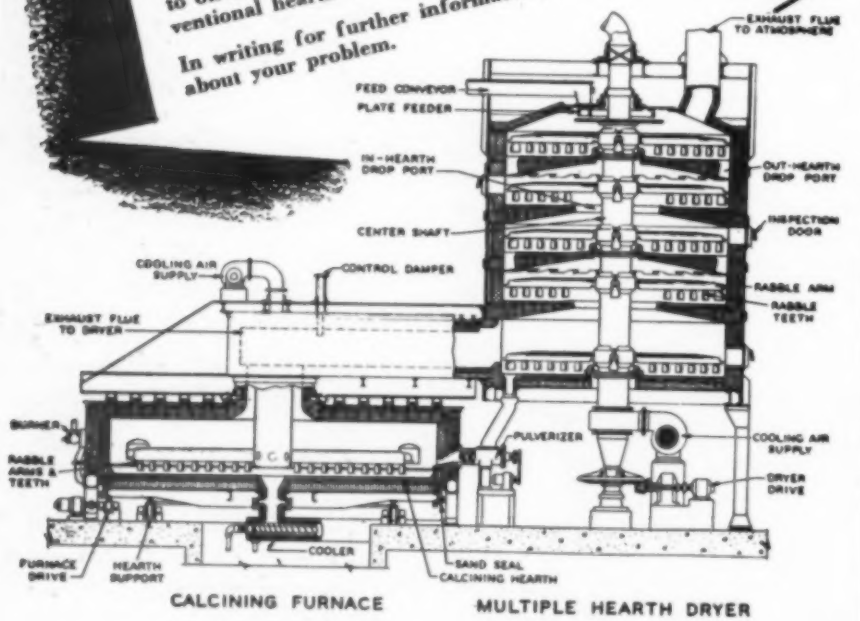
The conventional multiple hearth furnace is limited to temperatures of 1800° to 2000°F due to unavoidable conditions in which the fire brick hearths are subjected to heat from both sides.

By contrast, the calciner section of the Martin Furnace is designed to handle temperatures up to 2500°F. It's a single chamber furnace in which the brickwork can allow very high temperatures with durability and heating efficiency corresponding to other chamber type furnaces. It also has a rotating hearth in combination with a stationary rabbling device which provides for continuous operation in a most uniform manner without creating hot spots in the material bed. The stirring device is, of course, insulated and cooled internally.

The waste heat from the calciner is used to dry and/or preheat the material feeding the calciner.

If you have any calcining or roasting job which requires a temperature ranging between 1800° and 2500°F you should investigate the Martin Calciner/Preheater. If your process calls for lower temperatures, the multiple hearth section alone with its revolving rabble arms and fixed hearth has several things to offer which are great improvements over the conventional hearth furnaces.

In writing for further information, tell us in detail about your problem.



CALCINING FURNACE MULTIPLE HEARTH DRYER

Martin Furnace Division

MORSE BOULGER DESTRUCTOR CO.

211-0 East 42nd Street New York 17, N. Y.

headquarters and T. M. Robie has been named manager of the general diesel sales division.

Syntron Co., Homer City, Pa., has established a branch sales office at 4695 Sherbrooke St. West, Montreal, under the supervision of C. F. A. Gray.

Colorado Fuel and Iron Corp., New York, has named H. C. Allington general manager of sales of the Wickwire Spencer Steel division.

Pittsburgh Plate Glass Co., Pittsburgh, has appointed William L. Platt Boston sales manager for the Columbia Chemical division.

Globe Steel Tubes Co., Milwaukee, has made Frederick K. Krell Chicago district sales representative.

International Paper Co., New York, has announced a construction program for the coming year involving the expenditure of $25 million.

Ethyl Corp., New York, has elected Stanley T. Crossland, vice president and director, as treasurer and Charles L. McCuen, vice president of General Motors, as a director.

Sherwin-Williams Co., Cleveland, has started operation at the new synthetic resin manufacturing unit at Emeryville, Calif.

Centro Research Laboratories, Briarcliff Manor, N. Y., have announced an association with C.T.A.B., Haarlem, Holland. Chemisch-Technisch Adviesbureau is jointly directed by Dr. J. Rinse and W. Dorst.

Fansteel Metallurgical Corp., North Chicago, Ill., has acquired all outstanding stock of the Weiger-Weed Co., Detroit. The new subsidiary will continue to operate under its own name as a division of Fansteel.

American Pacific Industrial Corp., New York, has opened offices at 70 East 45th St. Officers are: John W. Foster, president; Dr. Lee Fah Yih, executive vice president; Kenneth W. Newman, vice president; and Ting-Lin Shang, vice president.

Ortho Pharmaceutical Corp, Raritan, N. J., has established a plant at High Wycombe, Buckinghamshire County, England. The new unit began operations in September.

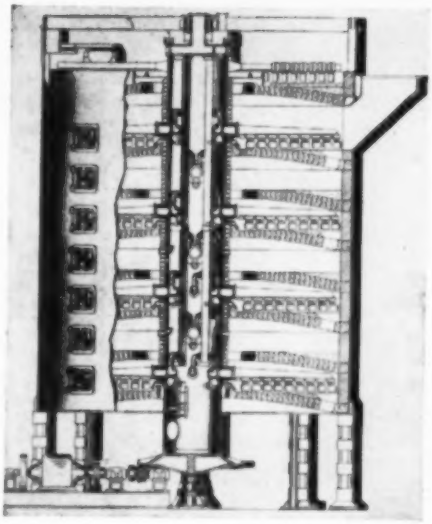
Ross Heater & Mfg. Co., Inc., Buffalo, has named Chain Gear, Inc., as Washington representative. Offices are at 820 First Ave., South, Seattle, Wash.

NOW AVAILABLE TO INDUSTRY

1—A grouping of engineering experience.
2—A combination of furnace designs.
3—Unsurpassed application "know how".
4—Complete plants engineered.

The Two Foremost

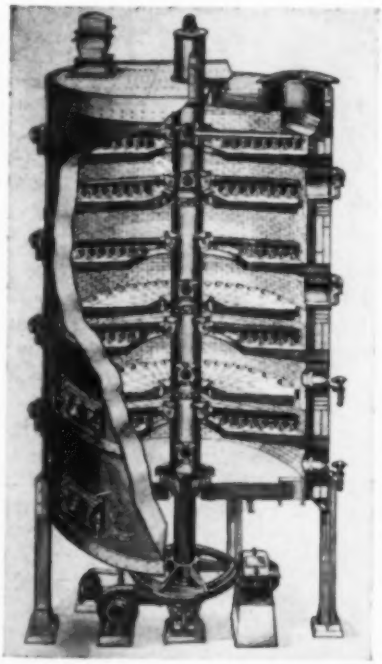
MULTIPLE HEARTH FURNACES



Bethlehem Wedge Roaster

The Bethlehem Wedge Roaster—a multiple hearth furnace requiring no introduction to the mining and metallurgical industries and other fields for more than 4 decades.

Roasting
Calcining
Drying



Nichols Herreshoff Multiple Hearth Furnace

The Nichols Herreshoff Multiple Hearth Furnace—the first successful multiple nearth air-cooled furnace for the roasting of ores. Extensively used for nearly 60 years in the metallurgical, chemical and other industrial fields.

NICHOLS ENGINEERING & RESEARCH CORPORATION
60 WALL TOWER, NEW YORK 5, N. Y.
University Tower Bldg., Montreal, Canada

SCRUBBING CORROSIVE GASES ?

Fig. 645

Are your scrubbing nozzles as efficient as you think they *could* be? Do they resist the corrosion or wear conditions satisfactorily? Produce the breakup and distribution you would like?

Right now thousands of Monarch Fig. 645 nozzles are scrubbing all kinds of gases all over the world .... Perhaps they can do a *better* job *for you!*

Outline your spray problem for us—if your liquid can be sprayed with direct pressure at all—Monarch can furnish the nozzles.

NOZZLES FOR:

- OIL ATOMIZING
- HUMIDIFYING
- AIR WASHING
- DESUPERHEATING
- SPRAY PONDS
- MILK POWDERING
- ACID CHAMBERS
- CONCRETE CURING

Write for Catalogs 6-A and 6-C

MONARCH MFG. WKS. INC.

2513 E. ONTARIO ST.

PHILADELPHIA 34, PA.

CONVENTION PAPER ABSTRACTS

(Based on papers presented at Conference on Western Chemical Markets sponsored by Western Chemical Market Research Group, Pacific Chemical Exposition, Oct. 21, 1947)

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Protective Coatings Industry Is Based on Chemicals

To EVALUATE the western paint and varnish industry as a consumer of chemicals will involve a certain amount of speculation, although we have attempted to compile accurate data on the consumption of the volume chemicals. Many of the published data are based on national consumption without distinction as to the amount consumed by West Coast industries; therefore, where data were not available, it was necessary, in many cases, to estimate consumption based on a percentage of the national total.

We chose a ten year period—1936 to 1946—and are presenting data showing the consumption of various chemicals during the three years 1936, 1941 and 1946. This shows the growth of the industry over a ten year period and yet does not include the war years. In 1936, the industry consumed approximately 8 percent of the total amount of chemicals consumed by the protective coating industry nationally. This figure in 1941 rose to 10 percent and in 1946, to approximately 12 percent.

It is interesting to note that the industry showed total sales in 1941 40 percent greater than in 1936 and the total in 1946 was 100 percent greater than 1936.

Protective Coatings

	1936	1941	1946
Sales, millions of dollars			
Total U. S.	444	623	897
Pacific Coast	36	62	108
Production, millions of pounds			
Total U. S.	280	400	500
Pacific Coast	22	40	60

Fundamentally, raw materials for paints, varnishes and lacquers, or protective coatings as we prefer to call them, fall into three general classifications; namely, pigments, vehicles and solvents.

Pigments on which our industry was built, namely lead carbonate, lead sulphate and zinc oxide, show very little change over this 10-yr. period. However lithopone, titanium dioxide, extended titanium pigments and leaded zinc oxide have shown large tonnage increases. However, due to limited production capacity and limited raw materials, the figures indicate the maximum that the industry was able to secure rather than the maximum it was able to consume.

The figures for consumption of inorganic colored, or opaque, hiding pigments are self-explanatory. Figures on organic color consumption are incomplete and do not give a true picture. Hundreds of organic toners and lakes are produced most of which are used in relatively small quantities.

Extender, or non-hiding, pigments, while high in tonnage will be quite low in dollar value yet they are an important part of our industry.

Fluctuation can, and does, take place in vegetable oil consumption. Large increases in linseed oil are comparable to the growth of the industry generally. Terrific increase in soybean oil shows the inroad that alkyd resin has made into the protective coating field.

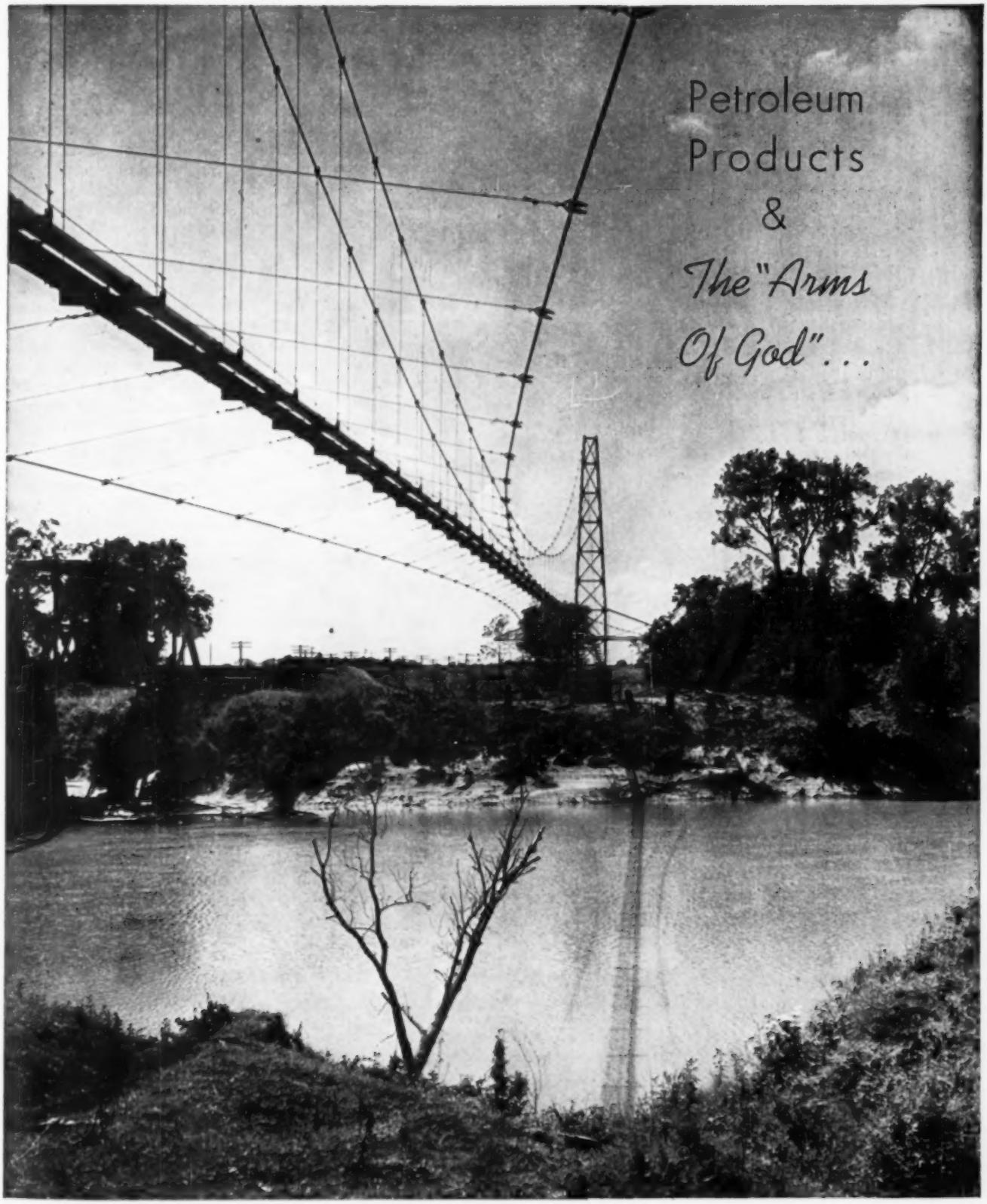
Raw Material Consumption by West Coast Protective Coatings Industry

	1936	1941	1946
Pigments, millions of pounds			
White hiding	67.9	95.5	100.3
Colored hiding	20.3	28.0	37.6
Colored organic	1.1	1.4	1.7
Extender	46.0	58.0	68.0
Vehicles, millions of pounds			
Oils	56.5	84.5	107.0
Resins (synthetic)	19.8	33.4	47.1
Resins (natural)	14.4	24.2	23.5
Solvents, millions of gallons			
Total	14.3	36.5	48.0

The synthetic resin industry, as an industrial development, is only 20 years old. The industry was really born —as a mass production industry—during the depression years, and started to gain momentum in 1935. From 1936 to 1946 there was an increase of 250 percent in West Coast consumption with a good portion of this increase in the glyceryl phthalate types.

Natural resins are about holding their own on a tonnage basis over the last ten years; however, since the total amount of material produced by the industry in general on the West Coast has increased steadily, the average amount of natural resin per gallon of material produced has steadily declined.

Decline in solvent plasticizer was probably due more to short supply than any other reason. The quantity



Legend says Spaniards fleeing Indians in Texas long ago were saved when a sudden flood in a stream they had just crossed stopped the savages. Thankfully, they named the protecting river the "Arms of God," in Spanish, "Brazos del Dios," now shortened to Brazos. Modern Brazos floods seem heedless of whose path they block, but flow of petroleum products in the 8-inch line above will never the interrupted. Brown & Root, Inc. have bridged the Brazos near Sealy with a 625-foot (between towers) pipe line crossing of their design, fabrication and erection. Take your river problems to Brown & Root, Inc.

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available for use in lacquers was supplemented by oil and resin type plasticizers to give the necessary degree of flexibility.

Cellulose derivatives—almost 100 percent being nitrocellulose in 1936 and still at least 95 percent of this material in 1946—have continued to increase in use on the West Coast although nationally there has been approximately a 13 percent decrease in lacquer sales. Protein binders are also increasing in volume according to available estimates.

The increased use of solvents follows the increase in coatings on the West Coast. The really significant changes are not indicated by the data given here. Between 1941 and 1946 there has been the large development of high aromatic petroleum products here on the Coast and even the production of such items as toluol and xyol from petroleum rather than from coal tar.

Another change which is not indicated is the large increase in ketone solvents and alcohols derived from petroleum between the years 1936 and 1946.

We are extremely optimistic about the future of our industry on the West Coast. The war years taught us much and wrought innumerable changes in our industry. In providing our great West Coast shipbuilding and aircraft industries with every conceivable type of coating we made advances which will be reflected in years to come. A tremendous market lies ahead of us, one which will see in excess of a $100,000,000 sales volume this year (1947) for the West Coast alone and a national volume of close to $1,000,000,000.

Merrill W. Reece and Herbert L. Wampner, Reichhold Chemicals, Inc., S. San Francisco.

Increase in Plastics Production Predicted

IN 1947 the West Coast plastics industry used directly in their own processing plants 39,814,000 lb. of chemicals for plastic materials production.

On the West Coast we have six large plastic material manufacturers, all making resins for the wood working industry. In addition, we have five or six smaller companies making specialty products, molding compounds casting resins, etc. We have 47 molders, 11 laminators, and 47 fabricators, and a large paint and varnish industry who not only buy resins but make many of their own.

Breaking down our production of plastic materials by classes, we have only the thermosetting phenolic types —ureas and alkyd resins for coating work—made on the Coast. There is no production of cellulose derivatives, vinyl plastics or other thermoplastics.

Our molding industry processes about 6 million lb. of phenolic molding powder; 2,500,000 lb. of ureas and 7½ million lb. of thermoplastics a year —much less than our 14 percent of the national total. This is because we do not yet have the assembly type of industry that consumes the large volume of molded parts, and our molding industry is young without well developed merchandising practice. Our molders have a capacity of about twice their present production. We have one large high pressure laminating plant, but at present most resins for this work are shipped in. Low pressure laminators are increasing rapidly and are reaching a rate of 1½ million lb. per yr.

Laminates and composite laminates of wood and paper bid fair to grow rapidly. Various estimates indicate that impregnated paper for the plywood overlay market alone should reach 30 million lb. of phenolic resin per year on the West Coast within five years. These figures sound fantastic until one realizes that in 1935 there was no resin production of any kind on the West Coast and molders used only 300,000 lb. per year.

At present our plywood industry obtains about 20 percent of the phenolic resins and 50 percent or more of the ureas from eastern sources.

Our consumption of vinyl resins per se is negligible and even in the finished articles we fall below our 14 percent consumer goods average. In vinyls we use only 5-8 percent of the United States production. In other words, except for vinyls, we consume in end-use products at least our 14 percent average and in special field uses much higher. We produce only about 3 or 4 percent or one-fourth of our consumption. The accompanying table emphasizes the fact that we now make plastics for two fields only—plywood and coating.

Trends that are not yet apparent in figures indicate large increases in phenolics for paper impregnation, a rapid increase in polyester usage for low pressure laminating with probable manufacture on the Coast; a large increase in paper and textile treating resins which will be made; a large volume for hardboard bonding and most probably the production of cellulose esters and vinyls. It is a fair estimate that in five years we will be producing all our end-use requirements in plastics materials and two or three times that volume in phenolics which will be processed into products for eastern consumption.

Today we ship east many products

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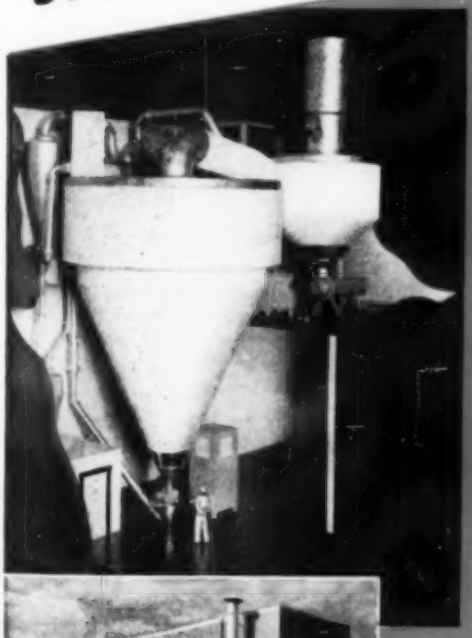

Above: Model Swenson Gray-Jensen Spray Dryer showing principal units of the system.

Below: Swenson Research Plant runs spray drying tests of various foods and chemicals.

EACH DOT SHOWS ONE OR MORE INSTALLATIONS IN SERVICE

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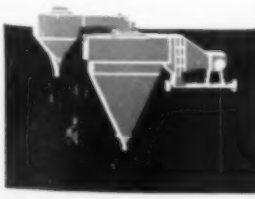

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Chemicals Used in 1947 by West Coast Plastics Industry

Product	Made in West	Used in West, Lb.
Phenol, 40 deg	none	8,064,000
Urea, tech	none	500,000
Formaldehyde, 37%	1,390,000 lb.[1]	13,900,000
Cresylic acids	petroleum grades	1,120,000
Caustic soda, 50%[2]	100%	3,780,000
Phthalic anhydride, C. P.	almost all	6,800,000
Glycerine, C. P.	none	1,900,000
Maleic anhydride, C. P.	none	1,000,000
Pentaerythritol, C. P.	none	1,500,000
Solvents[3]	none	500,000
Miscellaneous		750,000
		39,814,000

[1] Capacity on West Coast for 8,400,000 lb. [2] Includes only direct usage, not lacquer or coating solvents. [3] Not including chemicals for protein adhesives.

Chemicals for Plastic Materials in 1953 A West Coast Guesstimate

(Millions of Pounds)

	1947	1953
Phenols	8.1	24.0
Formaldehyde	13.9	38.0
Other aldehydes	...	4.0
Urea	0.5	1.0
Cresylic acids	1.1	6.0
Acetylene	....	15.0
Cellulose	....	10.0
Phthalic anhydride	6.8	12.0
Maleic anhydride	1.0	4.0
Solvents	0.5	5.0
Pentaerythritol	1.5	3.0
Caustic soda, 50%	3.8	11.3
Glycerine	1.9	3.0
Furanes	...	5.0
Misc	0.8	1.5
	39.9	142.8

End Use of Plastics on the West Coast

(Millions of Pounds)

	End Use	Production
Cellulose esters and ethers	18.6	none
Phenolic resins		
Molding compounds	18.6	0.25
Other uses	16.0	12
Ureas and melamines		
Molding powder	5.4	none
Other uses	12	1
Polystyrene	7.5	none
Other vinyls	9	none
Alkyds	20	10
Total	106.5	23.25

for plastics work—over 60 percent of the dissolving pulp used for cellulose esters. We also make petroleum cresylics, phthalic anhydride, ortho xylene, solvents of all types, and are anticipating a large phenol plant. In addition, we are being looked to as a source of benzol to supplement the coal-tar supply. We produce 20,000,000 lb. of wood bark fillers for plastics and are increasing our rate of production rapidly.

So the West Coast plastics industry resolves into two phases from the standpoint of the chemical industry.

1. As a direct consumer of chemicals—and at present we are very small except in two fields, plywood and coating. We have the raw materials for the other types and we have now substantial end-use markets. It seems reasonable to predict that in 1953 we will be consuming chemicals in the West Coast plastics industry at a rate at least equal to our population requirements.

2. Chemicals from wood, petroleum and our other material sources such as proteins coupled with our cheap power will make us a large factor in the supplying of base chemicals for processing into plastics in other areas.

Arthur J. Norton, consulting chemist, and Donald V. Redfern, American-Marietta Co., Seattle.

Agriculture Is Part of Everyone's Business

ROUGHLY 15 million tons of fertilizers were sold last year in the United States. Excluding gypsum, less than a half million tons go to the western states. Fertilizer sales for 1946 can be tabulated as shown (tons):

	California	Western States
Mixed fertilizer	271,677	319,109
Chemical nitrogen	183,374	236,986
Organic nitrogen	64,142	68,208
Phosphates	73,144	165,384
Potash	2,796	6,034

The nitrogen figures may be broken down further (tons used in 1946):

Ammonium nitrate	62,670
Ammonium sulphate	66,332
Calcium cyanamide	7,389
Sodium nitrate	20,787
Other chemical nitrogen	26,192
Dried manures	30,519
Other organic nitrogen	33,623

Inorganic arsenicals and fluorine compounds are still big factors in pest control. Although DDT is replacing much lead arsenate in codling moth control it is still estimated that between 4,000,000 and 10,000,000 lb. will be used in 1947 in the West. Basic lead arsenate, to the extent of 2,000,000 to 2,500,000 lb. is used principally on tomatoes, vegetables and cotton. Everyone would like to replace this to avoid stock and bee poisoning from drift of aeroplane dusting. Around 5,000,000 pounds of fluorine compounds are used, principally cryolite.

DDT consumption in agriculture is only a guess, but say 5-10,000,000 lb. for 1947 exclusive of household and barn sprays and mosquito control projects.

Petroleum oils probably divide into about 2,000,000 gal. of dormant season spray oil and 10,000,000 gal. of foliage or summer oil. Lime sulphur sales reach 3,000,000 gal. for insecticidal use only. Close to 2,000,000 lb. of HCN

Minor Insecticide Consumption in the Western States, Estimated for 1947

Paris green, lb.	10,000
Tartar emetic, lb.	50,000
Nicotine alkaloid, lb.	400,000
Pyrethrum (crops), lb.	400,000
Cube or derris root, lb.	400,000
Dinitro insecticide, lb.	2,000,000
Tar oils, gal.	30,000
Thiocyanates, lb.	10,000
Methyl bromide, lb.	300,000

Fungicides Used in Western States, Estimated

Sulphur dust, lb.	70,000,000
Lime sulphur fungicide, gal.	1,000,000
Copper compounds, lb.	12,000,000
Mercury compounds, lb.	18,000

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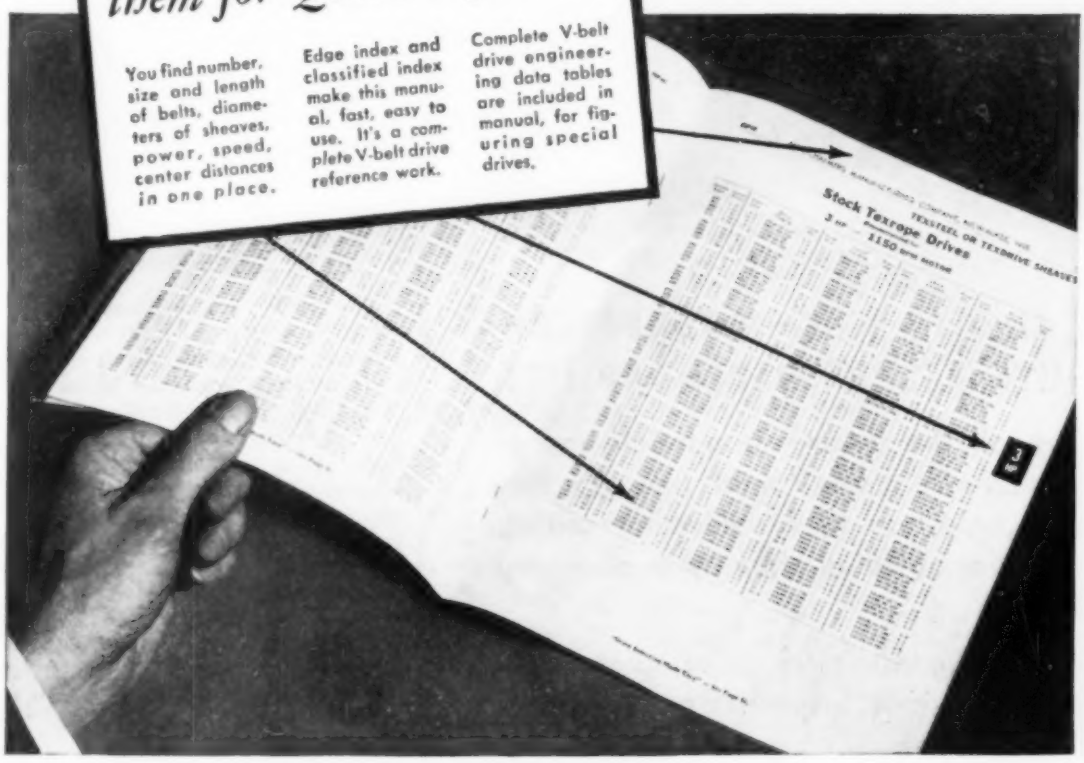
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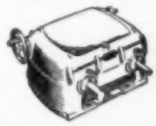

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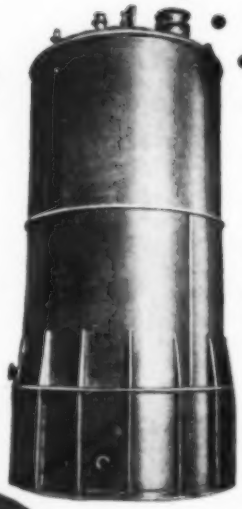

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and calcium cyanide are used in agricultural fumigations.

More money is spent on weed control than on all other forms of pest control. Most of it now goes for labor, but with high labor costs, a great demand for chemicals has arisen. Sodium chlorate, sodium arsenite, carbon bisulphide, petroleum oils, borax, 2,4-D, dinitro compounds, ammonium sulphamate and chlorinated benzene are also used in weed control.

In addition to the classified chemicals are literally hundreds of other chemicals used by agriculture for which highly specialized uses have developed.

Roy Hansberry, Shell Oil Co., Inc., Modesto, Calif.

Second Largest Consumer of Chemical Raw Materials

Pulp and paper production rates second as a consumer of chemical raw materials. Chemicals are used throughout all stages of the manufacture from that of pulping to the final finishing of the product.

Pulp and Paper Production, 1946

	Tons
U. S. paper production	19,180,000
Western states	1,565,000
U. S. pulp production	10,605,000
Western states	1,754,000

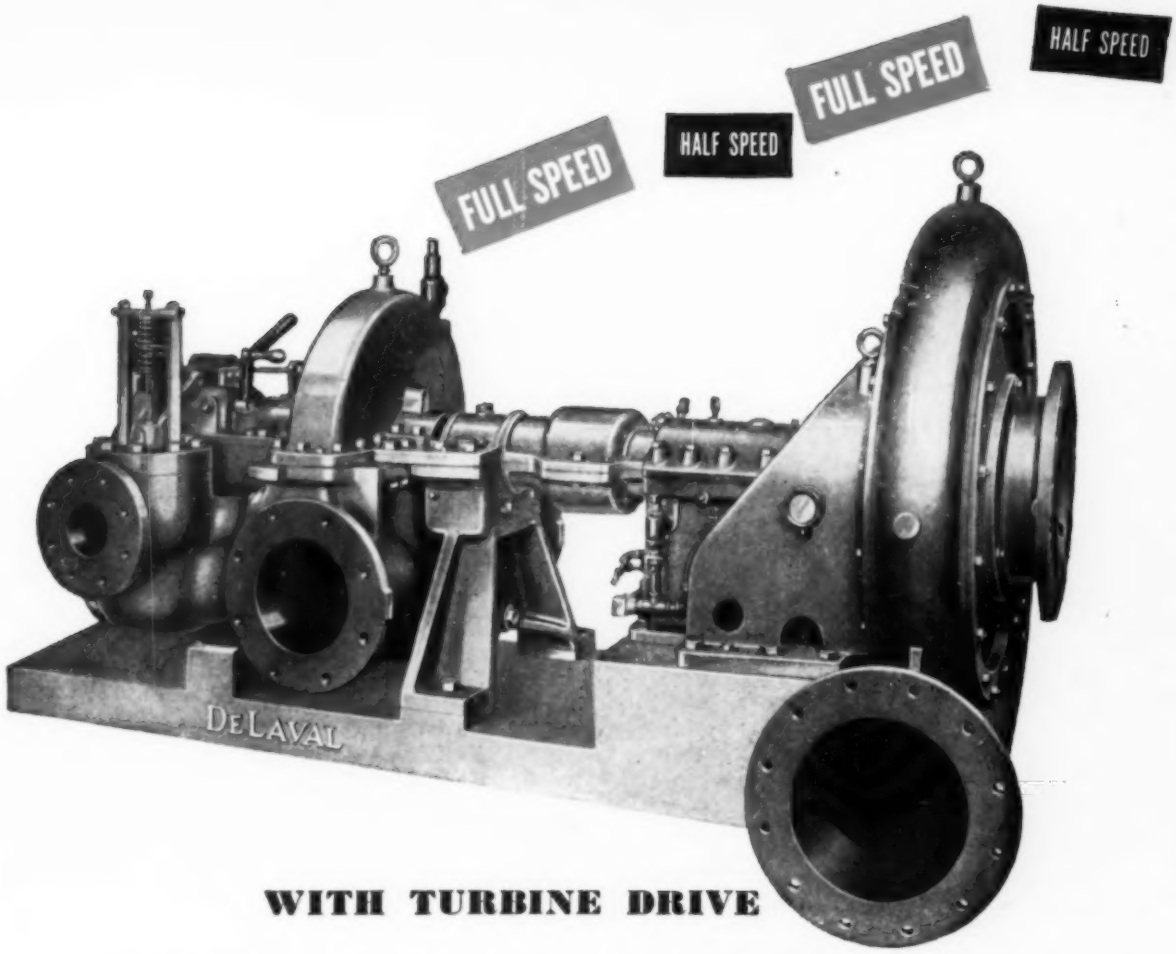
The sulphite process is one in which the cellulose is freed from the lignin and other incrusting matters in mild acid hydrolysis by the use of sulphurous acid in connection with a suitable base, the most common being lime. Dolomite is also fairly widely used. Magnesia base has been developed and considerable optimism is entertained for its future. Ammonia is in commercial production in one large pulp mill.

Inasmuch as they are very similar, the soda process may well be considered with that of sulphate. Both are alkaline in nature, depending upon the fact that alkali at high temperature solubilizes lignin and the other incrustants in wood, freeing the cellulose in fibrous form. In the soda process, soda ash and lime are reacted to produce a caustic soda cooking liquor. The sulphate process uses a caustic soda liquor, also, but in it a portion of the active alkali is sodium sulphide.

Chemicals Used in Primary Pulp Production by Pacific Coast Pulp & Paper Industries

	Tons
Sulphur	145,000
Limestone	173,000*
Lime	50,000*
Salt cake	60,000*
Soda ash	10,000*
Caustic soda	30,000*
Chlorine	50,000*
Rosin	19,000
Alum	15,000*
Clay	30,000
Asphalt	7,000*

* Produced locally.



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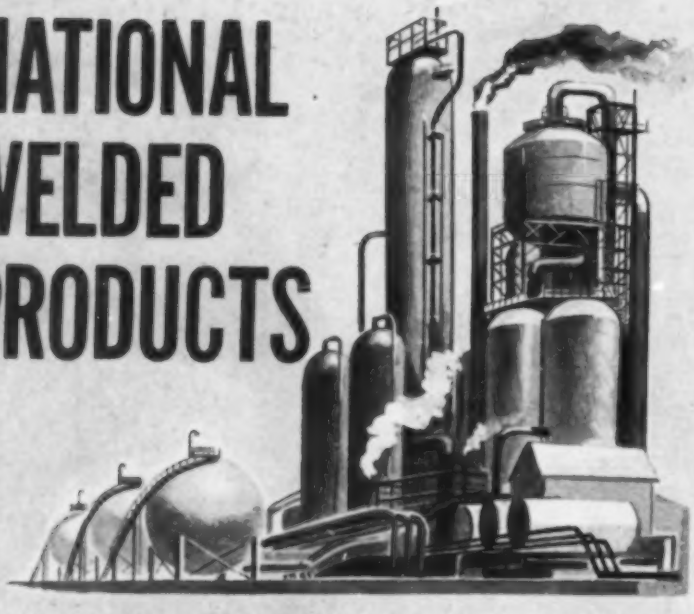

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Heretofore, the sulphite process has been of major importance on the Pacific Coast. However, upon the completion of the expansion programs under way and contemplated, the production of kraft pulp will equal or may even surpass that of sulphite. Chemicals for primary pulp production are sulphur, limestone, lime, salt cake, soda ash, and caustic soda.

R. G. Mispley, Crown Zellerbach Corp., Camas, Wash.

Foodstuffs Call For Chemicals

ALTHOUGH many questionnaires were sent out to food processors and chemical suppliers in order to get figures on the chemicals used in the West, there just was not sufficient information available to give estimates based on western uses. The figures given are based on national consumption, but

Chemicals Used by the U. S. Food Industry

Chemicals		Average Annual Value
Acidulants	$16,600,000	(total)
Citric		3,400,000
Tartaric		2,500,000
Lactic		1,300,000
Acetic		8,000,000
Bleaching and Aging Agents	$4,500,000	(total)
Hydrogen peroxide		45,000
Sulphur dioxide		950,000
Benzoyl peroxide		2,500,000
Potassium bromate		1,000,000
Certified Food Colors	$10,000,000	(total)
Emulsifiers and Stabilizers	$5,500,000	(total)
Gelatin		400,000
Pectin		5,000,000
Lecithin		25,000
Agar		.....
Flavoring Agents	$25,000,000	(total)
Mono-sodium glutamate		750,000
Spice		13,000,000
Synthetic flavoring agents		.....
Food Supplements	$6,500,000	(total)
Phosphorus compounds		6,000,000
Iron salts		400,000
Food Enrichment Agents (vitamins)	$41,500,000	(total)
Food Preservatives (including salt)	$2,000,000	(total)
Sanitation and Cleaning Compounds	$15,000,000	(total)
Total	$138,600,000	

perhaps some idea may be had as to the relative use of certain chemicals when we realize that the West produces essentially fruit and vegetable items, plus the fact that the state of California has now the largest dollar value ($2,110,000,000) of any state in the nation on agricultural products.

Theodore L. Swenson, Stanford Research Institute, Stanford University, Calif.

Chemicals for Silvaculture and Wood Processing

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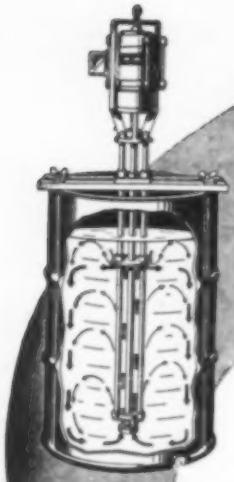

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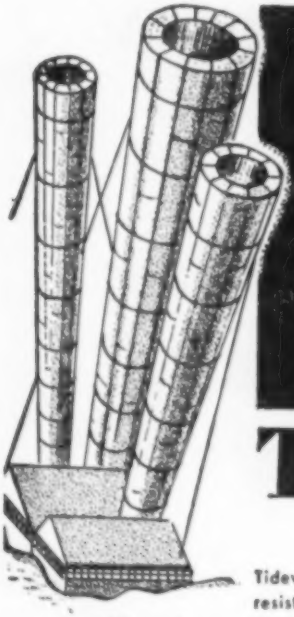

A WOOD *Naturally Resistant* TO ACIDS, ALKALIES AND DECAY

Tidewater RED CYPRESS

Tidewater Red Cypress serves better and lasts longer. It's natural resistance to acids, alkalies, etc. insures long and satisfactory results when used in vent stacks, pickling troughs, electroplating vats, etc. It's use under these conditions truly confirms its claim to being "The Wood Eternal".

If you have a particularly perplexing problem let us help you solve it. We invite inquiries concerning all types of tanks and vats . . . fully fabricated or partially fabricated.

The Wood Red Cypress "The Wood Eternal"

FLEISHEL LUMBER COMPANY

4232 Duncan Ave., St. Louis 19, Mo., NEwstead 2100

the inherent superiorities of the wood. Since wood is a renewable resource, a growing crop, preservation of its superiorities and correction of its deficiencies can well begin in the forests. Thus we have two main uses of chemicals in the wood industry: in silviculture, and in wood processing.

Use of chemicals in silviculture and associated fire-control work in the forests has been limited but is increasing. Various salts are used to kill undesirable species. Ammate, 2,4-D, and other weed killers are being tried experimentally to kill brush to reduce fire hazards. Some of the water-soluble fire-retardants have been used as sprays to reduce the fire-hazard of slashings.

Insect control has used much higher quantities of chemicals. Numerous chemicals, but principally DDT and arsenicals, are used as sprays and dusts.

Rodent control is another phase of the use of chemicals in silviculture. Several poisons, such as strychnine alkaloid, thallium sulphate and "1080" have been used.

Of the fire-retardants, sodium silicate, boric acid, borax, phosphoric acid, the ammonium phosphates and sodium phosphate are manufactured in the West. The Pacific Coast used approximately 384 thousand lb. of Minolith in 1944 and 1945 corresponding to 41.5 and 50.8 percent of the national consumption respectively. Minolith contains approximately 60 percent ammonium sulphate, 10 percent ammonium phosphate, 20 percent boric acid and 10 percent borax. The only other fire-retardant used in the West during these two years in significant quantities was chromated zinc chloride to the extent of 120 thousand lb. in 1944 and 41.5 thousand in 1945. The western consumption in 1944 was 75.8 percent of the national total but only 5.5 percent in 1945. Some 36 thousand pounds of Protexol was used on the Pacific Coast in 1944 but none in 1945. Protexol is a proprietary composition believed to differ from Minolith chiefly in having zinc chloride substituted for the latter's boric acid and borax.

Chemicals are used in the wood industry for dimensional stabilization primarily to prevent or reduce swelling and shrinkage. Generally speaking these chemicals are phenol-aldehyde, urea-aldehyde and dimethylolurea resins.

As far as is known no dimensional-stabilizing resins of the phenolic type are being used commercially on the Pacific Coast although quite a few companies have used them experimentally.

Formerly shellac was used to seal knots in place, but today it is being gradually replaced by a sealer com-

A telephone listens to a loud speaker in the new "free field" acoustic test room at Bell Telephone Laboratories. The sound-transparent "floor" is built of steel cables.

Test-tube for Sound

This giant "test-tube" is actually an echoless sound room at Bell Telephone Laboratories. Here engineers seek new facts about sound which will help them make telephone service still better and more dependable.

Bell scientists know a great deal about what happens to sound in electrical systems. This new room will give them a powerful tool to find out more about what happens to sound in the air.

In an ordinary living room, most of the sound addressed to you comes by way of reflections. At 10 feet less than 10% reaches you directly.

Sound that bounces at you from walls, ceilings, furniture, and your body is all right for hearing—but it poses questions for scientists who would study it uncontaminated by reflections.

The Bell Laboratories "test-tube" gives telephone people the chance to produce pure sound and analyze it reliably with respect to intensity, pitch, and direction. The entire room is lined with glass wool, contained in wire-mesh cases, wedge-shaped to give maximum absorbing area. Sound bounces along the sloping surfaces, sifts into the soft glass wool, and is gradually stifled.

This is one more example of Bell Laboratories' constant work to learn more about everything which can extend and improve telephone service.

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Florite* DESICCANT

The high-pressure dehydration unit here illustrated is a property of the United Gas Pipe Line Company at Carthage, Texas. It represents the most advanced design, construction, and operating technique; and the drying agent employed is FLORITE DESICCANT. The Stone & Webster Engineering Corporation, who designed and constructed the plant, are users of FLORITE in various types of equipment, large and small, for oil and gas companies and for other branches of industry.

Natural gas, propane, butane, gasoline, air, nitrogen, carbon dioxide, refrigeration compounds, all are treated with superior drying efficiency by use of FLORITE. Selectively adsorbs 4 to 20% its weight of water—is regenerated by heating to 350°F. Write for literature, names of important users in your own field.

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FLORIDIN COMPANY
ADSORBENTS

Department A, 220 Liberty St. Warren, Pa.

posed of a phenolic resin, polyvinyl butyral and denatured alcohol.

The laminated wood industry employs wood pieces of comparatively small size and glues them together with the grain parallel to produce pieces of greater size, improved strength, curvature or other special characteristics. While this branch of the laminating industry is in its infancy today, the potential market that it offers for chemicals appears attractive.

Today the western softwood plywood industry produces between 95 and 99 percent of the national total. 97 percent of the western production is from Douglas fir, and the remaining 3 percent is from Ponderosa pine. Based on an assumed average coverage of 120 lb. per M sq. ft. of plywood, the current annual consumption of phenolic resin in plywood cladding is estimated at 1.3 million lb.

Clark C. Heritage, Weyerhaeuser Timber Co., Longview, Wash.

Wood Preservatives Used in the West, 1946

Domestic coal-tar creosote, gal.[1]	31,200,000
Solutions, creosote & coal-tar, gal.	231,000
Solutions, creosote & petroleum, gal.[2]	30,000,000
Chromated zinc chloride, lb.	588,000
Wolman salts, lb.[3]	301,000
Pentachlorophenol, lb.	10,000,000
Misc. salts, lb.	288,000

[1] Includes distillate coal-tar creosote used in solutions of creosote and petroleum. [2] Various percentages; creosote content included in item 1. [3] Mixtures of sodium fluoride, dinitrophenol and potassium bichromate. Other additives include sodium arsenate and ammonium phosphate.

Western Consumption of Adhesives and Chemicals in the Softwood Plywood Industry[1]

(Thousands of Pounds)

	1947 (First Half)	1946
Casein glue	2,600	3,600
Soybean glue	12,800	21,000
Phenolic resins[2]	16,800	23,600
Sodium silicate	4,000	6,200
Lime	1,600	2,600
Caustic soda	1,000	1,600
Other glues[3]	1,400	2,000

[1] Includes western pine plywood amounting to about 3 percent of the total protein glues. [2] Actual solids content (phenol aldehyde, caustic, etc.) is about 40 percent of these figures. [3] Urea consumption currently estimated at 700,000 lb. annually in plywood mills.

Petroleum Pays $45,000,000 Per Year for Chemicals

Raw and finished chemicals will cost the western petroleum industry between 42½ and 45 million dollars during 1947. Based upon present forecasts the industry's consumption for 1948 will be the same or slightly greater.

In arriving at this chemical expense figure, consideration was given to approximately forty different chemicals as representing the greatest importance

AIR ECONOMY

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When you buy a fan, you naturally want it to deliver the required *volume* of air—at correct *pressure*—without wasting *power*. You want quiet, trouble-free service for a good many years. The wrong type and size of fan is a waste of money, while the *right* fan is the soundest kind of economy.

This is why "Buffalo" builds all types. There are "Buffalo" fans to handle 33,000 TONS OF AIR IN A DAY—and "Buffalo" fans to ventilate small rooms—draft fans for every type of furnace—exhausters to remove materials, air or corrosive fumes—disc fans, centrifugal fans, axial flows—all in such wide ranges of capacities that you can pick the most economical and efficient fan! BEFORE YOU SELECT A FAN, you'll save money by looking into the "Buffalo" line. Why not write us for the "fan facts" concerning your air problem?

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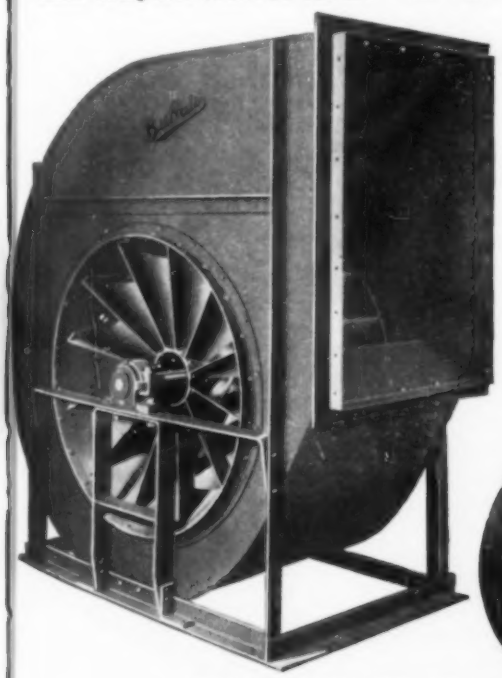

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NEED LARGE VOLUMES OF AIR for ventilation? "Buffalo" Limit-Load Fans do it quietly and use little power. Ideal where installation is near curved duct connections. Note directional inlet vanes which minimize wasteful turbulence. IN capacities from 600 to a half-million cfm. *Write for bulletin 3339.*

INDUSTRY CALLS THIS THE "CLEAN" FAN. The new "Buffalo" Industrial Exhauster will handle any removal problem feasible with a pneumatic system. Furnished with air wheels or material wheels as desired. Rivetless housing and rotor construction give amazing efficiencies. *Bulletin 3576, yours on request, gives all engineering data.*

"Buffalo" E Blowers are "specialists" in small furnace and forge blowing — gas line boosting — pressure cleaning jobs. These fans are money-savers in applications calling for small volumes against 0 to 3.65" static pressures. *Write for Bulletin No. 3014-C.*

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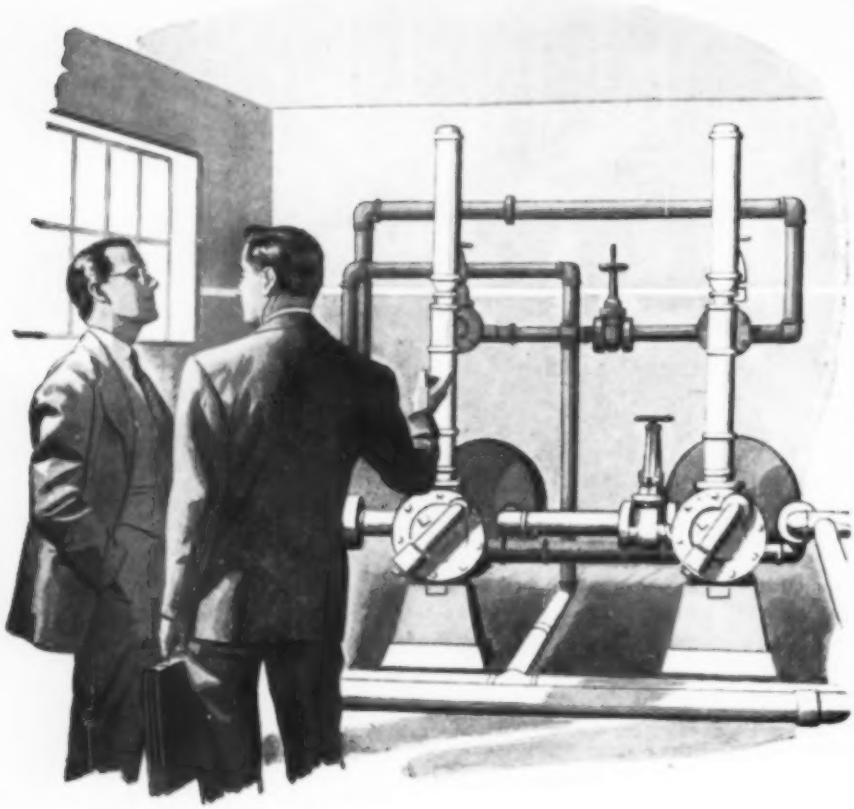

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Planning to install new fire protection equipment in pump rooms—or other spots where flammable liquids are handled or stored?

You'll find it worth while to talk to a Kidde representative!

He can help you decide just what kind of equipment will most effectively—and economically—safeguard each danger-spot... built-in systems, wheeled units or portable extinguishers.

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FIRE PROTECTION HEADQUARTERS

in the industry. No attempt was made to break down the components of specialty items. No consideration was given to research, as the research list runs into the hundreds of items and the over-all value negligible, many purchases being not much more than grams and ounces.

As an approach to the most authentic result, we called upon each of the seven major companies to contribute information concerning chemicals of largest monetary value, such as sulphuric acid, catalysts, caustic soda, fatty acids, phenol, filtering clays, sulphur dioxide and ammonia, but not including gasoline or motor oil additives and other specialty chemical items where consumption figures are available from one or a few suppliers. The total figure breaks down as follows:

Chemicals for refining and manufacturing	$20,171,000
Gasoline & motor oil additives & dyes	12,874,000
Field dept., chiefly mud chemicals	7,500,000
Specialty chemicals including detergents	1,680,000
	$ 42,225,000

In consideration of the ten most important chemicals used in refining and manufacturing, they shape up as follows:

Sulphuric acid	270,000 tons	$3,636,616
Catalyst	14,000 tons	2,500,000
Tallow and fatty acids		2,400,000
Caustic soda	43,000 tons	2,000,000
Filtering clays	17,000 tons	765,000
Phenol	6,500,000 lb.	750,000
Benzol	3,000,000 gal.	500,000
Ammonia	2,560,000 lb.	375,000
Methyl ethyl ketone	3,400,000 lb.	306,000
Sulphur dioxide	3,242 tons	217,000
		$13,449,616

Phosphoric acid, hydrofluoric acid and litharge complete the list of chemicals of some importance, each of these representing a total expenditure of between $100,000 to $200,000.

Today the western petroleum industry has an expenditure of almost 13 million dollars per year for chemicals added to our product to improve quality and meet the ever greater demands of automotive engineering.

With few exceptions, all modern oil field drilling is by the rotary method. A constant stream of muddy fluid is pumped through the drill pipe to the openings in the bit. This phase of oil drilling is rapidly developing into a highly chemicalized problem. There is a wide range of cost in mud, from 80 cents to $13 per bbl. Each well may use from 800 to 1,000 bbl. Considering the 1,700 wells drilled last year, it makes a lot of mud. Therefore, based on the best estimates, the weighted average should make a cost of about 7½ million dollars.

Specialty chemicals account for $1,880,000. Water is one of the trouble makers, accounting largely for

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use of specialty chemicals. In general the chemicals used include alum, sodium aluminate, silicate, lime, ash, caustic and others. Boiler water treatment utilizes phosphates, tannins, lignins, sodium sulphates, and others. Slime and algae are combatted with chlorine, hypochlorite, phenol derivatives, copper sulphates, bromine, mercuricals and others.

E. H. Weaver, Union Oil Co. of California, Los Angeles.

FOREIGN LITERATURE ABSTRACTS

Nickel Ore Treatment

INVESTIGATION was made of the ammonia method for hydrometallurgical treatment of eluvial nickel ores. Ammonia leaching of nickel monoxide, as well as silicate-oxidized nickel minerals and ores, without preliminary reduction, results in unsatisfactory extraction of nickel in solution. Preliminary reduction does improve the process considerably. Nickel can be extracted fairly effectively by direct reduction with subsequent ammonia leaching, from its silicate minerals, alumino-silicate minerals, and silicate-oxidized minerals. Optimum conditions were determined for high extraction (up to 94.63 percent) from neporite-garnierite by direct reduction followed by ammonia leaching, and from nickel aluminosilicate (up to 96.51 percent). More than 72 percent extraction of nickel was obtained from silicate-oxidized nickel ores. From the point of view of completeness of nickel extraction and duration of process, the ammonia method of leaching reduced silicate-oxidized nickel ores is considerably less effective than the earlier developed methods of chlorination and sulphuric acid leaching.

Digest from "Ammonia Method of Hydrometallurgical Treatment of Eluvial Nickel Ores" by D. P. Bogatsky and A. S. Semenova, *Zhurnal Prikladnoi Khimii* XX, No. 1-2, 89-96, 1947. (Published in Russia.)

German Production of Organic Intermediates

PRACTICALLY all of the dye production in Germany has been under the control of I. G. Farbenindustrie, which put out up to 2,500 different dyes, of which approximately 65 percent was exported. Up to 4,000 different intermediate products were required as raw materials for these dyes as well as for pharmaceutical products and plastics.

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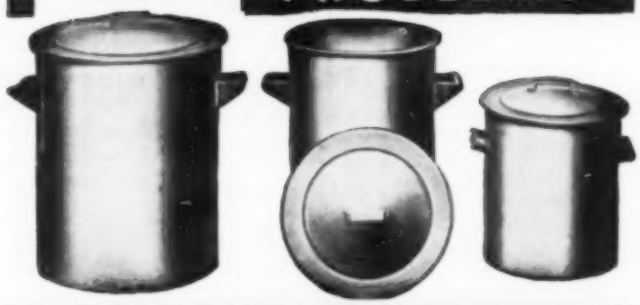

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(Patents applied for)

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Guaranteed efficiencies. These single stage, single suction, corrosion-resistant pumps use totally enclosed impellers. All liquid passages are streamlined for maximum efficiency, quiet operation, and minimum wear. Smooth sloping characteristics have sharp break-off to limit maximum horsepower requirements. All sizes of pumps are available either as pedestal-type for coupling connection to any type of drive, or close-coupled to a face-type motor.

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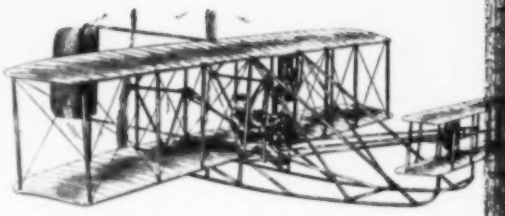
The intermediate products (chlorobenzene, phenol, salicylic acid) were also manufactured by other firms (Heyden, Rutgerswerke, Raschig). The I.G. intermediate products were manufactured at seven dye-producing plants (Leverkusen, Höchst, Ludwigshafen, Wolfen, Meinkuhr, Offenbach, Jurdingen) and some of them at several plants which did not manufacture dyes (Griesheim, Schkopau and several others). Most of the intermediate products intended for the market were produced at one plant and only some 20 of the large-tonnage products were produced at two to three plants. The basic raw material—aromatic hydrocarbons and some heterocyclic compounds—was obtained from the products of the destructive distillation of coal (chiefly by coking) 75 percent of which was carried out directly at the coal mines. Tar from gas plants was used to a lesser degree. The coke plants produced, in addition to coke, 90-deg. benzene, pure benzene, toluene and xylene, solvent naphtha, phenolate solutions (from ammonia water and crude benzene) and coal tar. Tars and phenolate solutions were treated at special plants (chiefly of the firm Gesellschaft fur Teerverwertung and Rutgerswerke). The tar was distilled chiefly in stills. There were also continuous units operating on the principle of fractional condensation (Dusburg- Meiderich, capacity 100,000 tons per year) and fractional evaporation (Raschig in Ludwigshafen, four systems of 14,400 tons per year each). A total of up to 2,300,000 tons of tar was treated per year (1942). I.G. used 90-deg. benzene, solvent naphtha, pyridine bases, a mixture and separate isomers of cresols, pressed and crystallized naphthalene, pure diphenylene oxide, fluorene, acenaphthene and 40-percent anthracene for the manufacture of intermediate products. 90-Deg. benzene was distilled to pure benzene, toluene and a mixture of xylenes directly at the dye plants in batch stills with plate columns. The mixture of xylenes was separated by distillation to the 138-139 deg. fraction (xylene F) containing 65-70 percent meta-, 20-22 percent para- and 5 percent ortho-isomer and the 143-144 deg. fraction containing chiefly o-xylene. Sometimes separate isomers were isolated by freezing (para at -55 deg.) or by sulphonation and fractional hydrolysis. The necessary pseudocumene (1,2,4,-trimethyl benzene) was separated from the solvent naphtha in the form of its 5-sulpho acid. The crude (40 percent) anthracene was converted to the 93-95 percent product by double recrystallization from pyridine bases. Pure (97-98 percent) carbazole was obtained from the filtrate after the solvent was driven



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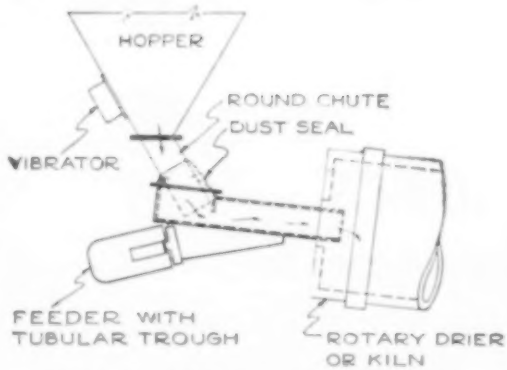

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off by double recrystallization from chlorobenzene. In recent years carbazole has been used chiefly for the manufacture of insecticides rather than dyes, using tetranitrocarbazole for combating grapevine pests (Nirosan). Diphenyl, tetralin and diphenylene sulphide were also used to some extent as raw materials. These products were not separated from coal-tar but were obtained: diphenyl by pyrolysis of benzine, tetralin by hydrogeneration of naphthalene, and diphenyl sulphide by the action of sulphur on diphenyl in the presence of aluminum chloride. Organic raw material: benzine, naphthalene, anthracene, tolune, carbazole, pyridine bases, xylene, etc. was used for the manufacture of 60,000 tons of dyes (maximum prewar output). It should be noted that the quantity of raw material used guarantees the manufacture of intermediate products required for the manufacture of dyes. The total production of separate important products (aniline, phenol, phthalic anhydride) many times exceeded their consumption for the manufacture of dyes.

Digest from "Manufacture of Intermediate Products at German Plants" by N.N. Vorozhtsov, *Khimicheskaya Promyshlennost* No. 6, 176-181, 1947. (Published in Russia.)

Polyvinyl Chloride Pastes

Polyvinyl chloride is used in the form of a white powder of varying grain size which can be molded or extruded at high temperature to produce rigid forms. Addition of plasticizers such as tricresyl phosphate, butyl phthalate, octyl sebacate, produces objects of a softer and more pliable nature. The greater the content of plasticizer, the lower the temperature at which these objects remain pliable. A sufficient quantity of plasticizer will result in a viscous mixture which consists of a suspension of solid grains of polyvinyl chloride in liquid plasticizer. Such polyvinyl chloride pastes are much simpler to work with in making sheets or objects than the more solid form. Such pastes are in the form of liquids with a density of a little more than 1, are viscous, range from yellowish white to a clear yellow brown, are slightly translucent, and flow into a smooth thread with more or less readiness, depending on the viscosity. These pastes are excellent for the manufacture of special fabrics and papers and they can be molded into different shapes simply by heating the paste in hollow forms in a hot-air oven or even in a hot liquid.

Digest from "Polyvinyl Chloride Pastes" by M. Chazal, *Recueil des Conferences, Journee Lyonnaise des Matieres Plastiques*, April 19, 1947, 55-61. (Published in France.)

CHEMICAL ENGINEER'S BOOKSHELF

Lester B. Pope, ASSISTANT EDITOR

For Colour Merchants

PIGMENTS, THEIR MANUFACTURE AND PROPERTIES. *By John Stewart Remington. Leonard Hill Limited, 17 Stratford Place, W. 1, London, 179 pages, 12s.*

Reviewed by Myron A. Coler

IN HIS prefatory remarks, the author expresses the hope that "this book will be found of interest to paint manufacturers, colour merchants, and students, as well as to all those who, apart from business interests, desire to gain some insight into the various products produced by the British colour industry." It is difficult to believe that this book presents a balanced and up-to-date insight into present British practices. The selection and page weighting of subjects appear to have been carried out on a somewhat personal basis. Thus, 15 pages are accorded to basic carbonate white lead and 27 pages to zinc oxide and leaded zinc oxide whereas titanium dioxide appears to rate not quite 4 pages. No mention is made of the existence of rutile and anatase forms. Similarly, 23 pages are given to ultramarine and a scattered total of less than one page to the phthalocyanine pigments.

Considerable energy is devoted to pointing out the unquestioned value of British contributions to modern pigment technology but much less effort is made to present the relevant technical data. Thus it is stated in the introduction: "Perhaps the greatest advance has been made in the organic colour field during the last twenty years. Today our range of intermediates, pigment dyestuffs and lakes will rank with any country in the world. Amongst other things, fastness to light, increased stability and dispersion have all been carefully studied and considered, so that today the paint, printing-ink, rubber, cellulose lacquer and plastic trades have a range of pigments which, as regards their uniformity and physical properties, are equal to any made in Germany or America." Yet Section XXVII, entitled "Organic Colouring Matters," is comprised of less than 19 sketchy pages of which over 5 pages are concerned with a partially repetitive discussion of extender bases and specific gravity tables for tannic acid, aluminum sulphate and tartar emetic solutions.

Typographical and technical errors are not uncommon. The index and chapter headings are not too helpful: China clay and silica are discussed in the chapter entitled "Gypsum or Terra Alba"; phthalocyanine pigments are discussed under "Ferrocyanide Blue" and again without cross-indexing under "Cobalt Blue and Cobalt Violet." The section on red lead and zinc chromate devotes three sentences to the use of red lead as an anti-corrosive material; no mention is made of the related use of zinc chromate.

Guaranteed Wages

THE GUARANTEE OF ANNUAL WAGES. *By A. D. H. Kaplan. The Brookings Institution, Washington, D. C. 269 pages. $3.50.*

Reviewed by H. C. Parmelee

CAN employers in business and industry guarantee an annual wage to their employees?

Whenever this question is raised in otherwise well informed circles, someone is almost certain to reply in the affirmative and cite George J. Hormel & Co., meat packers of Austin, Minn., and the Nunn-Bush Shoe Co., Milwaukee, Wis., as bright and shining examples of regularity of income for hourly workers. But there the citation usually stops; and an easy jump may be made to the conclusion that the policy is generally applicable throughout industry. Unfortunately, all is not gold that glitters; nor is the experience of a few isolated concerns producing consumers' goods necessarily applicable to heavy industry like steel, in which regularity of employment and income are greatly to be desired. Hence the timely value of the current impartial study by the Brookings Institution, in which Mr. Kaplan explores the economic implications of nation-wide adoption of a guaranteed annual wage by all industry. It seems questionable, in the light of Mr. Kaplan's inquiry, whether either labor or management would be willing, or wise, to accept full responsibility for the impact of guaranteed annual wages on employment, production, marketing, and investment policies; on technological progress, and freedom of opportunity to buy and produce; to say nothing of the almost inevitable role of government in maintaining stable employment and payrolls.

Organized labor's position on the guaranteed annual wage is divided. Broadly speaking, CIO favors the policy and proposes its adoption on an industry-wide basis among steel, automobile, and shipyard and marine workers. AFL, on the other hand, rejects the policy as applicable to all industries, and prefers to consider it as a matter for collective bargaining, to be adopted on a voluntary, not compulsory, basis. In general, the policy is favored by the newer unions and in those largely expanded during the war, and opposed by the older and the craft unions.

Management has been responsible for initiating most of the existing annual-wage plans. They vary so widely, however, in basic principles and practices that they are not easily fitted into neat classifications. The companies adopting them and the employees covered comprise only a small fraction of industry, and are to be found mainly in nondurable consumer goods and services. Numerous plans

RECENT BOOKS RECEIVED

Fundamentals of Statistics. By T. L. Kelley. Harvard. $10.

Industrial Experimentation. By K. A. Brownlee. Chemical. $3.75.

Industrial Management. 4th ed. By W. R. Spriegel & R. H. Lansburgh. Wiley. $5.

Modern Polishes and Specialties. By W. D. John. Chemical. $7.50.

Organic Analytical Reagents. Vol. III. By F. J. Welcher. Van Nostrand. $8.

Powder Metallurgy. By H. H. Hausner. Chemical. $7.

Practical Emulsions. By H. Bennett. Chemical. $8.50.

Pressure Vessels for Industry. By H. M. Spring, Jr. McGraw-Hill. $3.50.

Pyrotechnics. By G. W. Weingart. Chemical. $7.

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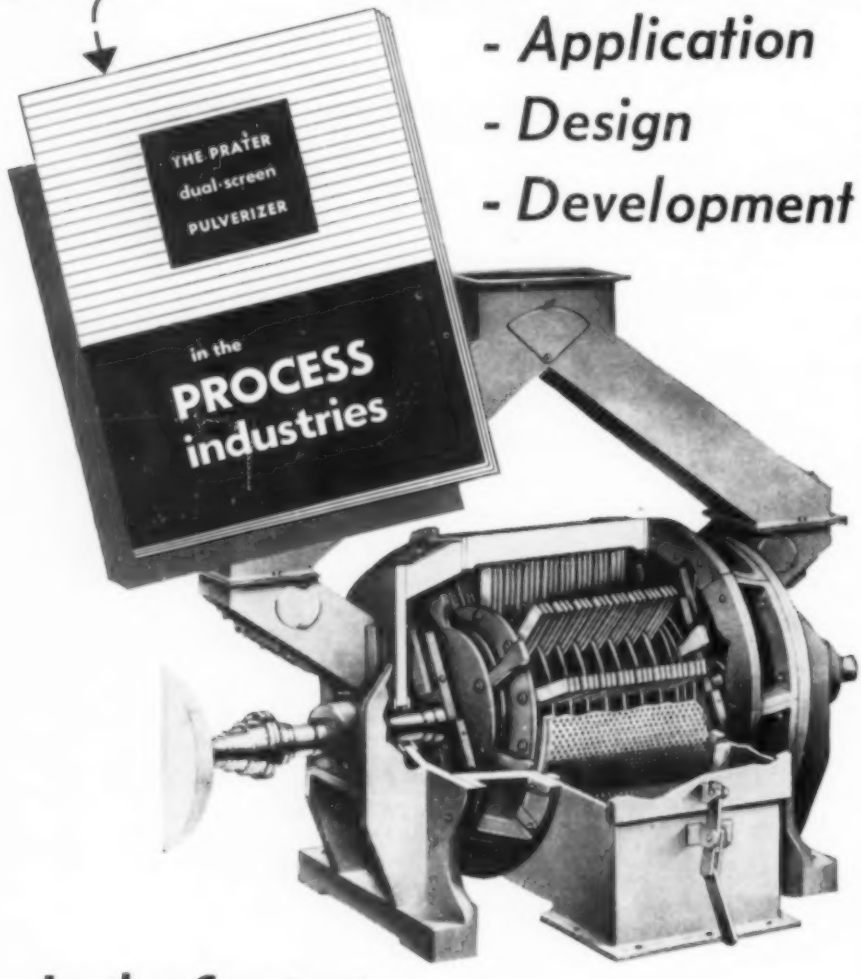

In the Constant Progress of the Process Industries

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that were operative in the prosperous 1920's fell by the wayside in the succeeding decade.

Superficial consideration of the guaranteed annual wage policy is likely to oversimplify its operation and benefits without digging deeply enough into the consequences of requiring management to accept full-time payrolls as overhead. Those who are confronted with a decision in the matter should study carefully the results of the present inquiry.

From Britain

COLLOID SCIENCE—A SYMPOSIUM. *Chemical Publishing Co., Brooklyn. 208 pages. $6.*

Reviewed by Jerome Alexander

THIS book comes from one of the great research laboratories of the world, presided over by Eric K. Rideal, who has also served as president of the Society of Chemical Industry (London). The papers are mainly theoretical, although applications to biology, medicine and industry continually crop up. In a foreword, the editor states that the text of his symposium was taken from a series of lectures given as a course in colloid science at Cambridge University, Cambridge, England. "The growing interest in colloid systems, polymers and macromolecules justifies the publication of these inspiring and informative lectures in book form."

Various topics are, for the most part, treated mathematically, and in the condensed form suitable for a syllabus. Years ago Prof. William Stratford used to remark: "The professor wearies himself in condensing so that the student may weary himself in expanding." The professor has the right to expect that his students can fill in intermediate calculations, but he is there to aid those who happen to be mathematically deficient. The book will therefore be of great use to teachers in these advanced fields, and though it may demand much of the students who use it, this is a stimulus to thought and to work.

The numerous references included in most of the chapters indicate that much consideration has been given to work covering the decade 1935-1945, especially English work. The complexity of the systems treated and the great number and variability of the factors acting, necessitate many simplifying assumptions in order that principles may be developed. This means that in individual cases, the importance and value of each factor must be suitably assessed. The fields dealt with may be judged from the following abstract of the contents: *Introduction*, by Prof. Rideal. 4 p.

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Surface Chemistry and Colloids, by A. E. Alexander, 52 p.; *Thermodynamics and Colloidal Systems*, by D. D. Eley, 15 p.; *The Study of Macromolecules by Ultracentrifuge, Electrophoresis, and Diffusion Measurements*, by P. Johnson, 15 p.; *The Viscosity of Macromolecules in Solution*, by F. Eirich, 15 p.; *The Kinetic Theory of High Elasticity*, by R. F. Tuckett, 8 p.; *Emulsions in Vivo*, by J. H. Schulman, 11 p.; *The Study of Colloidal Systems by X-Ray Analysis*, by M. F. Perutz, 15 p.; *Membrane Equilibrium*, by G. S. Adair, 14 p.; *Infra-Red Spectra and Colloids*, by G. B. B. M. Sutherland, 8 p.; *Vinyl Polymerization*, by R. R. Smith, 12 p.

Several statements demand consideration: Lawrence (*Ann. Rep. Chem. Soc.*, 37, 106, 1940) has shown the incorrectness of the statement of S. U. Pickering, appearing in all textbooks, that 99 percent by volume of oil can be emulsified in soap solutions. "Such systems consist in fact of a continuous oil phase thickened by a mass of hydrated soap crystallites, and so are not emulsions at all." (p. 24). The theory of Verzar as to the absorption of fat through the intestinal wall, is opposed by recent evidence; thus "paraffin in finely emulsified droplets, at least $\frac{1}{4}$ μ in diameter, is as equally well absorbed as olive oil, if negatively charged emulsifying agents are used." (p. 130).

Broad in Scope

THE CHEMISTRY OF PORTLAND CEMENT. *By Robert Herman Bogue. Reinhold Publishing Corp., New York.* 1947. 572 pages. $10.

Reviewed by J. C. Witt

FOR MORE than twenty years, Dr. Bogue has been the research director of the Portland Cement Association Fellowship at the National Bureau of Standards. His principal studies have been on the compounds of cement clinker and the hydration products of these compounds. In connection with his work, he has kept in close touch with the developments in cement chemistry around the world. The scientific information acquired in this way is the basis of the most recent, and one of the very good, books in his field of research.

The author defines clearly the scope of his book: "The work is written, therefore, primarily for the cement chemist, and from the point of view of the research chemist concerned with the chemical problems of the industry, but with the thought constantly in mind that the treatment should be such that the executive, the engineer or the lay reader should be able to profit by its study. . . .

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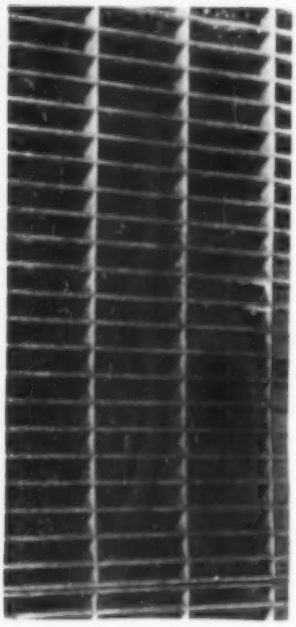

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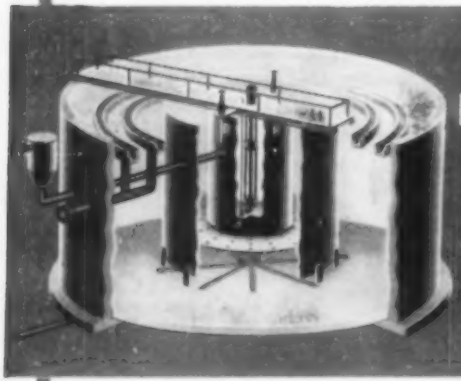

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My theme is the chemistry of portland cement, but other aspects are touched upon. . . . I have outlined the processes of cement manufacture, but only in brief, dwelling especially upon the operations which are chemical in nature. I have touched upon the physics of cement pastes and the design of concrete only incidentally, as affected by the chemical processes taking place. . . . The subject matter naturally divides itself into the two classifications: the chemistry of clinker formation, and the chemistry of cement utilization. The former is concerned chiefly with high-temperature reactions in the dry state, the latter with reactions between cement and water or solutions. These two fields of study compose Parts I and III, respectively. Both fields, however, are intimately concerned with the nature and stability of the phases which are formed under given conditions. So important is a knowledge of the technique and results of such an approach to the problems of cement that a separate section, Part II, is devoted exclusively to the Phase Equilibria of the cement systems."

Studies in either chemistry or portland cement should lead to the volume, which may be said to be at the crossroads of the two subjects. It should be enlightening to chemists not interested in cement who have erroneous ideas concerning the simplicity of cement chemistry. In most books on cement, the importance of chemistry is not sufficiently emphasized.

The volume should be of particular interest to several groups of individuals, of which the following may be mentioned: persons in the cement industry who are specializing in chemistry; persons in other nonmetallic inorganic industries who are specializing in chemicals; and research workers in the field of cement. An important feature is the hundreds of references presented. It is a useful guide to the literature of cement chemistry.

The discussion of the chemistry of cement in such detail has necessarily limited the treatment of other phases of the industry. If a reader does not find the book helpful over so wide a range as he had anticipated, it probably is because he failed to read the preface or to note that the manufacture of cement from the raw materials to the finished, tested product is explained in sixteen pages.

Chemical symbols and formulas are used interchangeably with abbreviations which resemble these symbols and formulas. The abbreviations are familiar to cement chemists, but a glossary is required for the guidance

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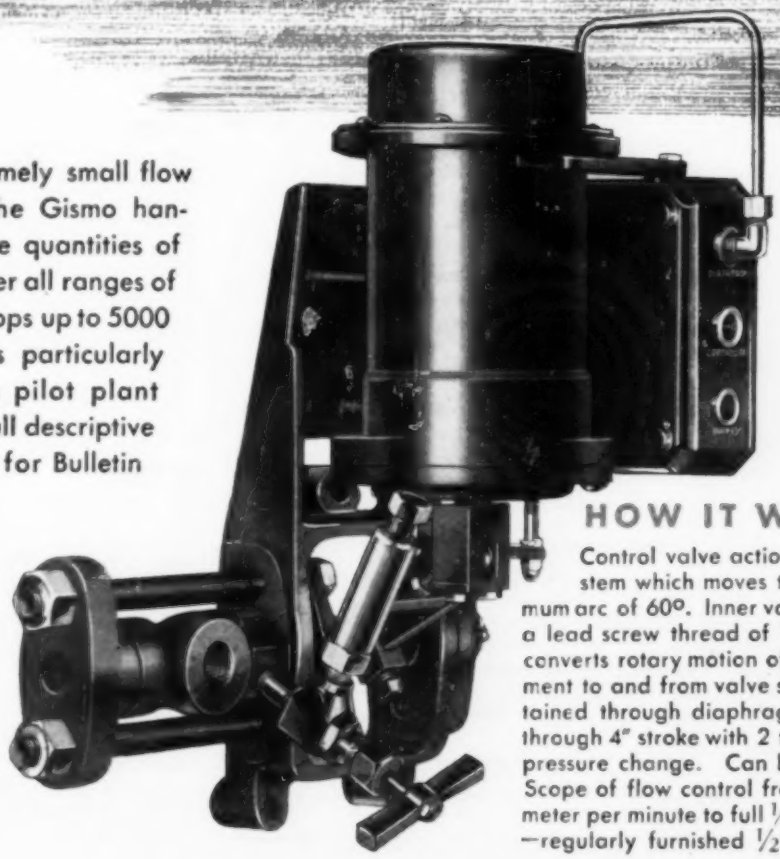

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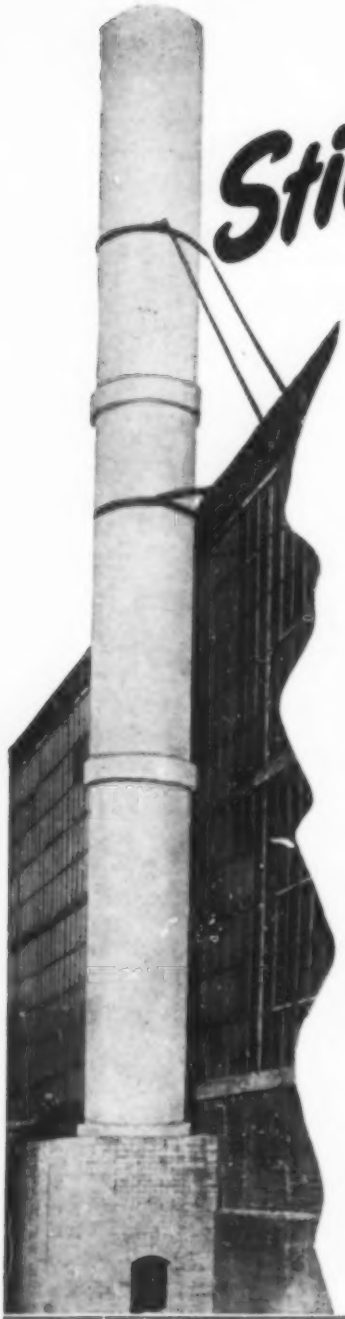

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of others. Although the practice is generally accepted, it is not conducive to the understanding of some portions of the book by lay readers, or by readers in general who have not specialized in cement.

There are many points about the manufacture and use of cement that are highly controversial. Consequently, the book contains some statements that could be challenged, or at least modified.

The author dedicates the volume to five of his colleagues at the Stockholm Symposium on The Chemistry of Cements in 1938, and he acknowledges his indebtedness to his associates on the staff of the Portland Cement Association Fellowship.

Manufacture and Use

THE ALKALINE EARTH AND HEAVY-METAL SOAPS. *By S. B. Elliott. Reinhold Publishing Corp., New York.* 342 *pages.* $7.50.

HERE is a comprehensive discussion of virtually all phases of manufacture and use of alkaline earth and heavy-metal soaps. Individual chapters cover constitution of the soaps, raw materials for manufacturing, solvents and addition agents, manufacturing methods and equipment, classification of soaps, applications of metallic soaps, and discussions of soaps of the eight metal groups. Appendixes cover patents specifications, applications, commercial metallic soaps and a list of inorganic compounds suitable for preparing metallic soaps for research.

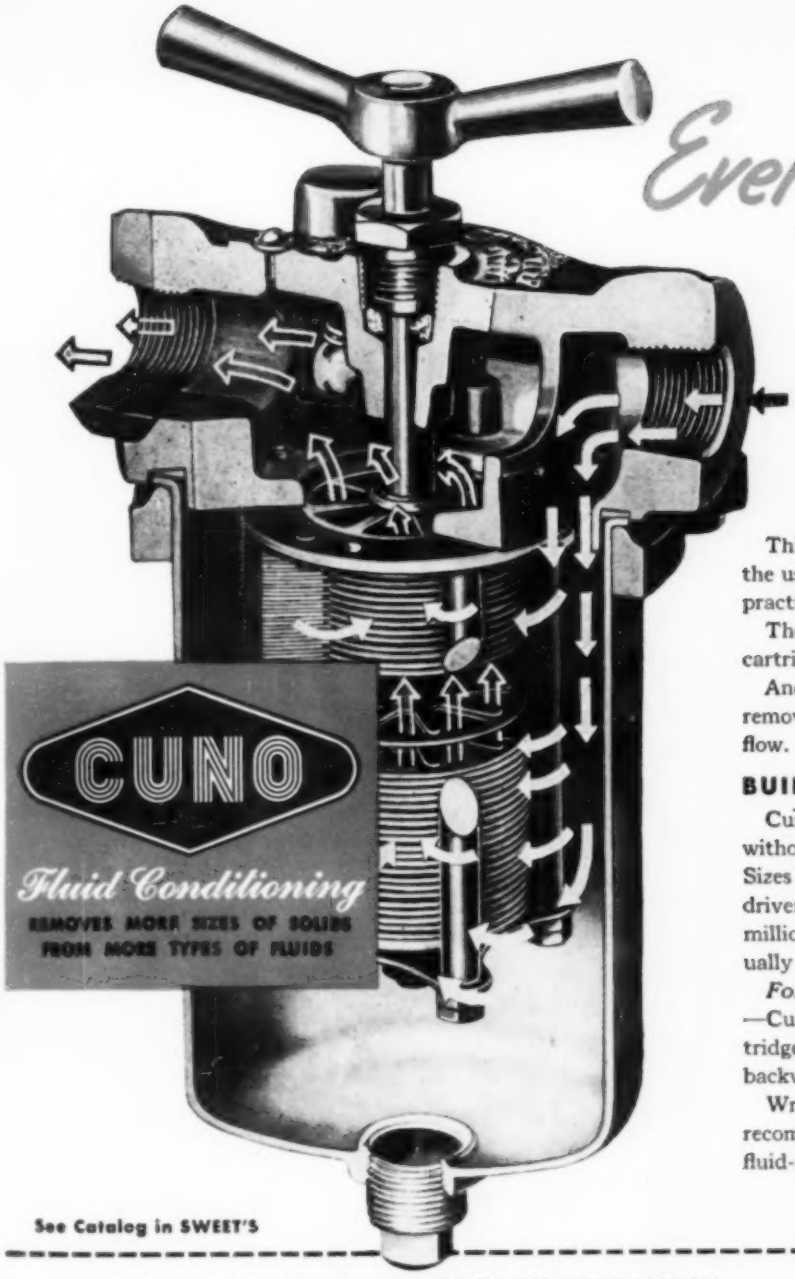
RECENT BOOKS and PAMPHLETS

Prevention of Deterioration Abstracts. Published by the National Research Council of the National Academy of Sciences, 2101 Constitution Ave., Wash., D. C. $37.50 per yr. Now available on a yearly subscription basis, these abstracts are set up under the following headings: electrical and electronic equipment; finished assemblies; fungicides; laquers, paints and varnishes; leather lubricants; metals; microorganisms; optical instruments; packaging; paper; plastics, resins, rubbers and waxes; storage; textiles, and wood.

India & America. By B. J. Vaswani. Published by Indo-American Fellowship. 90 pages. 50 cents. Points out what the American businessman should know about India.

Limitations in Cross-Laminating of Oak Under Extreme Service Conditions. Published by the Virginia Polytechnic Institute, Blacksburg, Va. By E. G. Stern. 48 pages. 50 cents. Bimonthly Bulletin of Virginia Polytechnic Institute, Engineering Experiment Station Series No. 66.

Levulinic Acid as a Source of Heterocyclic Compounds. By Avery A. Morton. Scientific Report Series No. 8, published by the Sugar Research Foundation, 52 Wall St., New York, N. Y. 28 pages. This review covers these four principal headings: the keto-acid system and re-



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☐Ammonia	☐Flavors	☐Resins
☐Animal Oils	☐Fuel Oil	☐Rubber Cements
☐Asphalt	☐Gases	☐Sizing
☐Banana Pulp	☐Gasoline	☐Soap
☐Beer	☐Glue	☐Solvents
☐Beverages	☐Grease	☐Syrups
☐Casein	☐Gum	☐Tar
☐Castor Oil	☐Hydrogenated Oil	☐Tooth Paste
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lated combinations, the keto-methylene and keto-methyl systems, the halogeno-keto and related systems, the acid chloride, ester or equivalent compound.

The Social Contract of an Educated Man. By Isaiah Bowman. 11 pages. An address delivered by the president of The Johns Hopkins University to entering students, Sept. 20, 1946.

Union List of Technical Periodicals in Two Hundred Libraries of the Science-Technology Group of the Special Libraries Association. Third edition. By Elizabeth G. Bowerman. Published by the Special Libraries Assn., 31 East Tenth St., New York 3, N. Y. 285 pages, $6. Nearly 5,000 titles of periodicals in representative special libraries in the fields of pure and applied science. Planographed.

New Method of Protecting Conveyor Openings. By Norman J. Thompson. Published by the National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass. 12 pages. 20 cents. Generously illustrated with graphs and photographs, this article was originally presented as an address at the fifty-first annual meeting of the NFPA.

Coal Evolution, Not Revolution. Published by the Research and Development Division, Pittsburgh Consolidated Coal Co., Library, Pa. 10 pages. A discussion of the fuel situation and a research project for the making of synthetic fuels from coal.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons or check. Do not send postage stamps. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

Statistics on Ethyl Alcohol (Fiscal Year Ended June 30, 1947). Bureau of Internal Revenue, Alcohol Tax Unit. Processed. Complete production data.

Departmental and Agency Statements on Research and Development Administration. The President's Scientific Research Board. Available from the office of John R. Steelman, Chairman. Processed. Summarizes present policies of many agencies.

Ecological and Physiological Studies of the Effect of Sulfate Pulp Mill Wastes on Oysters in the York River, Virginia. By Paul S. Galtsoff, et al. Fish and Wildlife Service, Fishery Bulletin 43. Price 50 cents. Elaborate research report and summary of recommendations.

U. S. Patents on Powder Metallurgy. National Bureau of Standards, Miscellaneous Publication M184. Price 30 cents. A bibliography.

Summary of Proceedings of Conference on Productivity, October 28-29, 1946. Bureau of Labor Statistics, Bulletin No. 913. Price 15 cents.

Wood Properties and Paint Durability. By F. L. Browne. U. S. Department of Agriculture, Miscellaneous Publication No. 629. Price 10 cents.

Committee of European Economic Co-operation. General Report, Volume I. Department of State Publication 2930. Price 30 cents. Summarizes requests from the Paris conference of sixteen

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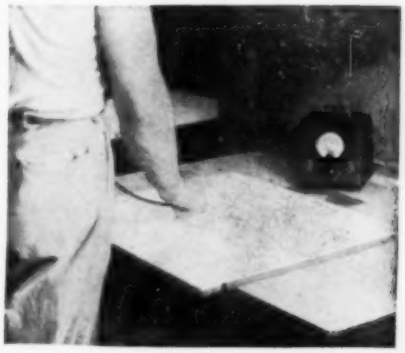

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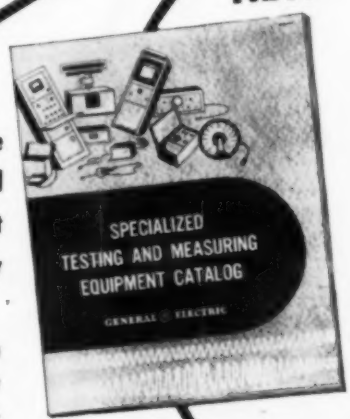

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Improvement and Industrial Utilization of Soybeans. U. S. Department of Agriculture, Miscellaneous Publication No. 623. Price 10 cents. Research summary of the Soybean Laboratory program.

Peanut Protein Fiber: Its Position in the Protein Fiber World. By Walter M. Scott. Bureau of Agricultural and Industrial Chemistry, AIC-165. Mimeographed. Summary of present status and economic prospects as judged by Southern Regional Research Laboratory.

Developmental Tests of Synthetic Organic Compounds as Insecticides. Part I. By M. C. Swingle, et al. Bureau of Entomology and Plant Quarantine, E-730. Processed. Tabular summary of results on individual chemicals with specific insects.

Housefly Control. By F. C. Bishopp and L. S. Henderson. U. S. Department of Agriculture Leaflet 182. Price 5 cents. A popular statement; but summarizes present technical judgment of Bureau of Entomology.

Production of Metallurgical Alumina from Pennsylvania Nodular Diaspore Clays. By J. E. Conley, et al. Bureau of Mines, Bulletin 465. Price 35 cents. Detailed report on wartime research project.

Toxicity and Flame Resistance of Thermosetting Plastics. By L. B. Berger, et al. Bureau of Mines, Report of Investigations R. I. 4134. Mimeographed. Complete report of experimental studies of reactions and toxic products.

German High-Temperature Coal-Tar Industry. By E. O. Rhodes. Bureau of Mines, Information Circular I. C. 7409. Mimeographed. Summarizes foreign observations.

Pott-Broche Coal-Extraction Process and Plant of Ruhröl, G.m.b.H., Bottrop-Welheim, Germany. By H. H. Lowry and H. J. Rose. Bureau of Mines, Information Circular I. C. 7426. Mimeographed. Resume of foreign observations.

Gasification of Lignite and Subbituminous Coal. By V. J. Parry, et al. Bureau of Mines, Report of Investigations R. I. 4128. Mimeographed. Progress Report for 1945-46. I. Operation of a commercial-scale plant at Grand Forks, N. D. II. Comparison of small and large pilot plants.

Inflammability of Dimethyl Ether- Dichlorodifluoromethane-Air Mixtures. By G. W. Jones and F. E. Scott. Bureau of Mines, Report of Inestigations R. I. 4125. Mimeographed.

Electric Smelting of Low-Grade Nickel Ores. By S. F. Ravitz. Bureau of Mines. Report of Investigations R. I. 4122. Mimeographed.

Beneficiation of Western Manganese Ores. By C. H. Schack and H. G. Poole. Bureau of Mines, Report of Investigations R. I. 4117. Mimeographed.

Pilot Mill Concentration of Las Vegas Wash Manganese Ore, Boulder City, Nev. By S. R. Zimmerley and C. H. Schack. Bureau of Mines, Report of Investigations R. I. 4123. Mimeographed.

Concentration of Oxide Manganese Ore from the Ophir Hill Mine, Ophir, Tooele County, Utah. By S. J. Hussey, et al. Bureau of Mines, Report of Investigations R. I. 4130. Mimeographed.

Vibrator-Type Multiple-Shot Blasting Unit. By F. C. Gibson and F. W. Brown. Bureau of Mines, Report of Investigations R. I. 4136. Mimeographed.

Alexander-Barber Sillimanite Properties, Spartanburg County, S. C. By R. C. Hickman. Bureau of Mines, Report of Investigations R. I. 4118. Mimeographed.

Investigation of Magnetite Deposits at Star Lake, St. Lawrence County, N. Y. (to November 1945). By W. T. Millar. Bureau of Mines, Report of Investigations R. I. 4127. Mimeographed.

Recovery of Soda and Removal of Sulfate in the Lime-Soda Process for Alumina Production. By Francis J. Frattali, et al. Bureau of Mines, Report of Investigations R. I. 4126. Mimeographed.

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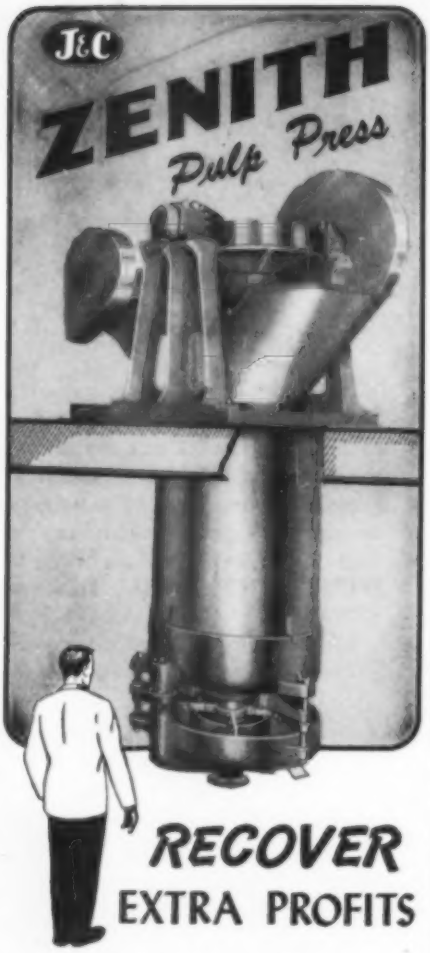

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made by this company for demineralizing water. Explains the operation principle of the equipment. Contains photographs and diagrams of the various models.

115. Materials Handling. Link-Belt Co., Chicago.—8-page leaflet illustrates and describes this company's ball bearing trolley for overhead conveyors. Diagrams various models. Includes list prices, dimensions and weights.

116. Fire Prevention. National Board of Fire Underwriters, New York.—16-page booklet discusses commercial fire hazards, fire protection and directions for handling fires.

117. Liquid Level Regulators. Mason-Neilan Regulator Co., Boston.—64-page bulletin covers the application, construction and operation of the liquid level controllers made by this company. Contains a well-labeled diagram for each piece of equipment. Includes drawings showing applications.

118. Carbon Tetrachloride. Stauffer Chemical Co., New York.—32-page booklet contains tables on physical properties, vapor pressure, azeotropic mixtures of carbon tetrachloride and solubility of water in carbon tetrachloride. Includes a section of binary mixtures, applications and safe handling.

119. Instruments. Fischer & Porter Co., Hatboro, Pa.—32-page booklet illustrates and describes this company's variable area type flow meter. Discusses principles of operation, flow range, linear flow characteristics and accuracy.

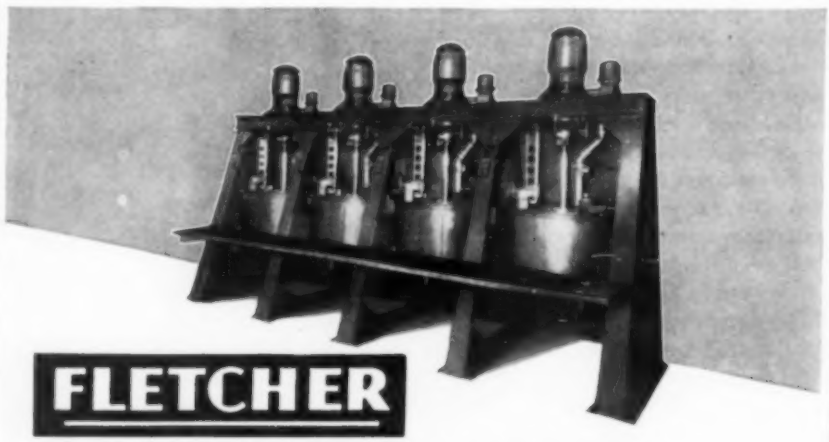
120. Silicaware. Amersil Co., Inc., Hillside, N. J.—16-page booklet illustrates and describes the fused silica and fused quartz products made by this company. Contains dimensions and sketches of pipes and fittings.

121. Chemicals. Publicker Industries Inc., Philadelphia.—8-page leaflet describes a surface active agent made by this company. Contains graphs showing solubility in sodium hydroxide, surface and interfacial tension, foaming capacity and wetting capacity.

122. Equipment. Bush Manufacturing Co., Hartford, Conn.—Three booklets describing and illustrating the heat transfer products made by this company. One 8-page booklet contains sketches and dimension charts of heavy duty coolers. A 4-page leaflet covers automatic water defrosting equipment. A 20-page booklet provides data on refrigerating and air conditioning equipment.

123. Rotary Sifters. B. F. Gump Co., Chicago.—12-page booklet illustrates and describes the line of rotary sifters made by this company. Contains graph showing operation, construction and installation of the sifters. Includes a 2-page comparison table for wire, silk, and grit gauze sifting cloth.

124. Instruments. Wheelco Instruments Co., Chicago.—Two booklets illustrate and describe this company's strip chart recorder. 16-page leaflet explains with text and schematic drawings the operating principle of the instrument. Contains a 2-page chart giving specifications. Also includes a chart giving tech-



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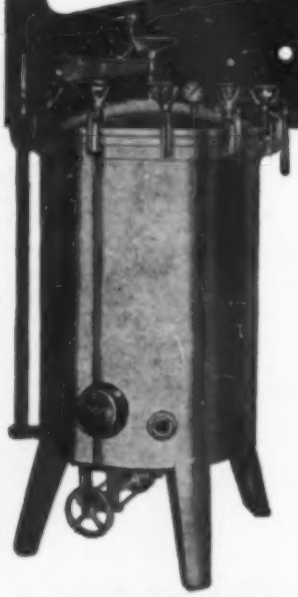

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140. Filters. Niagara Filter Corp., Buffalo, N. Y.—16-page booklet covering this company's filters for the chemical, food, fermentation and process industries. Contains two pages diagraming the complete operating principle of this company's filter. Includes a chart giving sizes, capacities and dimensional data.

141. Chemicals. Glyco Products Co., Inc., Brooklyn, N. Y.—100-page booklet describing the emulsifying agents, waxes and other chemicals made by this company. Contains formulas, physical and chemical properties and other data.

142. Wire Cloth. Buffalo Wire Works Co., Buffalo, N. Y.—4-page leaflet pictures the mesh sizes of the line of wire cloth made by this company. Includes a chart giving dimensions.

143. Instruments. Gow-Mac Instrument Co., Newark, N. J.—4-page folder describing this company's unit for analysing gas by measuring thermal conductivity. Diagrams a typical electrical circuit for gas measurement. Pictures the various models and contains specifications.

144. Valves. Caton Co., Newark, N. J.—Three 1-page flyers, two describing and illustrating the valves and one the strainers made by this company.

145. Conveyors. Food Machinery Corp., Riverside, Calif.—8-page booklet describing the portable conveyor made by this company. Illustrates some of the varied applications for this equipment.

146. Instruments. Fischer & Porter Co., Hatboro, Pa.—8-page leaflet picturing and describing the various flowmeter models made by this company.

147. Water Conditioning. Cochrane Corp., Philadelphia, Pa.—20-page booklet discussing this company's greensand zeolite water softening process and its equipment for the process. Contains cutaway views showing the operation of the equipment. Includes a two-page table giving dimensions, weights and list prices.

148. Synthetic Rubber. B. F. Goodrich Chemical Co., Cleveland, Ohio.—Bulletin 47-12 covers the handling and storage of Geon latex.

149. Alloys. The Duriron Co., Inc., Dayton, Ohio.—Bulletin 100. 4-page leaflet listing 155 corrosive chemicals alphabetically and showing which of this company's alloys offers the most satisfactory resistance to each. Mechanical properties of the alloys are also given.

150. Dryers. Proctor & Schwartz, Philadelphia, Pa.—12-page booklet describing the use of this company's continuous conveyor dryers in 11 different applications. Describes how the equipment was used and diagrams each set-up.

151. Flooring. Ralph V. Rulon, Inc., Philadelphia, Pa.—8-page leaflet describes this company's line of industrial flooring and protective coatings. Contains several photographs showing plants where their products have been used.

152. Instruments. Commercial Research Laboratories, Inc., Detroit, Mich.—Bulletin 905. 4-page leaflet discussing the performance, design and accuracy of this company's flowmeter. Contains a labeled diagram of the instrument. Considers installation, operation, maintenance and application.

153. Materials Handling. Towmotor Corp., Cleveland, Ohio.—28-page pocket-sized booklet describing the line of materials handling equipment made by this company.

154. Insulation. Geo. P. Reintjes Co., Kansas City, Mo.—4-page folder describing this company's tube and tile walls. Illustrates the insulation in use with the parts clearly labeled. Contains a cross-sectional diagram of an insulated wall.

155. Weigh-Feeder. Builders Providence Instruments, Providence, R. I.—Bulletin D8-550.35. 4-page leaflet diagraming

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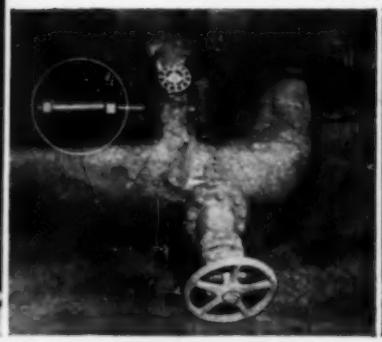

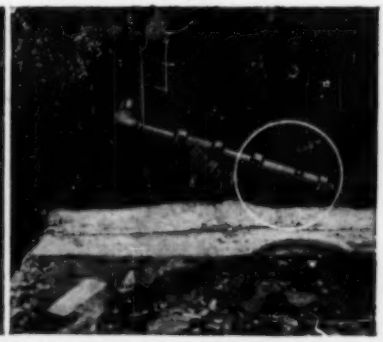

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SCHNEIBLE

nical data. 8-page leaflet contains well-labeled photographs of different views of the instrument.

125. Boiler Accessories. Cochrane Corp., Philadelphia.—16-page booklet illustrates and describes this company's continuous blowoff systems. Discusses the purpose and principles of the systems. Contains pictures showing diagrams of their continuous blowoff set-ups.

126. Steam Specialties. Wright-Austin Co., Detroit.—Bulletin CI 47. 4-page folder describes and illustrates the line of traps, strainers, etc., made by this company.

127. Bromine. Dow Chemical Co., Midland, Mich.—Booklet providing technical data on bromine and bromine products. Discusses both organic and inorganic compounds.

128. Equipment. Surface Combustion Corp., Toledo.—32-page booklet illustrates and describes this company's equipment for the heat treating of metals. Contains a tabular resume of prepared gas atmospheres giving composition, application, capacities and cost.

129. Screw Pumps. Sier-Bath Gear and Pump Co., North Bergen, N. J.—20-page catalog describes the capacity and applications of this company's screw pumps. Includes information on hp. ratings, viscosities, pump installation and maintenance.

130. Humidity Control. Surface Combustion Corp., Toledo.—8-page bulletin discussing this company's unit for humidity control in air conditioning systems for industrial processing. Contains a full-page flowsheet showing operation. Explains details of application. Shows several different installation views.

131. Materials Handling. Hewitt-Robins Inc., Passaic, N. J.—Bulletin 128-A. 16-page booklet illustrates and describes this company's equipment for the unloading of hopper-bottom cars.

132. Silicone Oils. Dow Corning Corp., Midland, Mich.—8-page data sheet covering this company's line of silicone oils for high temperature lubrication. Reports on comparative tests for stability, volatility, etc., made on these oils by the manufacturer.

133. Pumps. Cochrane Corp., Philadelphia.—4-page reprint entitled "High Pressure Return Cuts Power Waste." Discusses the use of this company's high-pressure condensate return pump.

134. Diffuser Tubes. Chicago Pump Co., Chicago.—Bulletin 177. 4-page leaflet illustrates and describes the performance and construction characteristics of this company's diffuser tubes. Includes a graph showing the wet performance of the tube. Contains material specifications.

135. Gas Analysis. Davis Emergency Equipment Co., Inc., Newark, N. J.—Bulletin 1143. 2-page leaflet describing and illustrating the micro-gas analyzer made by this company. Contains a one page toxicity table.

136. Equipment. Hydro-Power, Inc., Springfield, Ohio.—4-page leaflet discusses the hydraulic booster and pressure intensifier made by this company. Describes operation, lists sizes and dimensional information. Includes a schematic drawing of a typical hydraulic booster circuit.

137. Stainless Steel. Jessop Steel Co., Washington, Pa.—12-page booklet listing the stainless and heat-resisting steels made by this company. Contains charts giving chemical analyses, physical properties and fabricating properties of standard types of steel. Includes two pages of corrosion resistance ratings.

138. Instruments. Ess Instrument Co., Bergenfield, N. J.—2-page flyer describing the turbidity indicators and recorders made by this company. Includes sketches of their various parts.

139. Nickel. The International Nickel Co., Inc., New York, N. Y.—36-page booklet discussing the uses of the nickel alloys made by this company. Charts and text tell of the performance of the alloys under a variety of industrial con-

Auto-Lite Indicating Thermometer F-1, illustrated, can be supplied with adjustable, electrical alarm contacts at small additional cost. Hooked up with a bell transformer circuit, it gives a warning bell or light signal when temperature rises above desired level.

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Model "500" is designed for use where accurate charting of temperature is needed. In service, it complements the F-1 Indicating Thermometer for food lockers, quick freezing and other low temperature applications. Model "500" Recording Thermometers have either 24 hour or 7 day mechanical clock movement. Highly visible, 6" chart, with exceptional range coverage. Capillary tubing permits remote reading. Further details on request.

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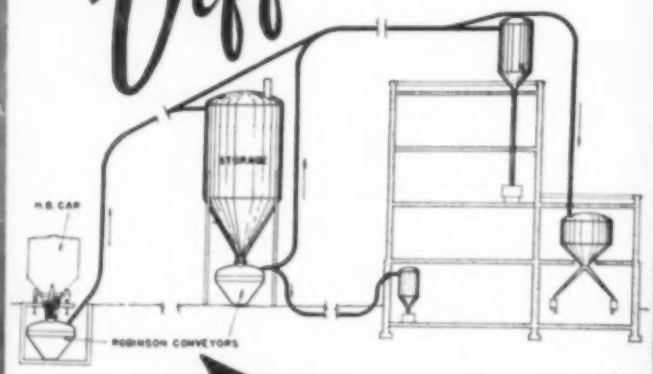
THE PNEUMATIC CONVEYOR THAT'S *Different*



"*Floating*" Material Through a Pipe is Better Than Blasting It Through

"*Floating*" It Through May Be Better Than Handling It Mechanically

WE are referring to the handling of dry, finely granular or pulverized materials in bulk into, through or out of the plant.

We are also referring to the unique way the material in the Robinson System is "fluffed" up into a cloud and then quickly conveyed through piping to its destination. The action might be likened to the flow of a liquid through a pipe. It's unique in pneumatic conveying methods.

Not only is the Robinson Air-Activated System already in use in many processing plants but within the past year it has been installed or ordered for handling such products as: litharage, borax, silica, soda ash, cement, carbon black, ammonium nitrate, limestone, starch, water softening chemicals.

Industry is finding out more and more about the Robinson Method for handling fine, dry, granular or pulverized materials in bulk. After investigating thoroughly many companies are ordering the system.

We'll be glad to hear about your handling problem and if there is any doubt, we'll be glad to make a pilot plant test.

ROBINSON *Air-Activated* Conveyor Systems

***Division of* MORSE BOULGER DESTRUCTOR CO.**

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and picturing the scales made by this company for continuous weighing of dry materials on conveyor belts. Presents the principle of operation. Includes typical specifications.

156. Regulators. Grove Regulator Co., Oakland, Calif.—6-page folder picturing and describing this company's check valves. Contains diagrams showing the dimensions of the various models and their operation.

157. Equipment. Cochrane Corp., Philadelphia, Pa.—4-page leaflet describing this company's equipment for removing corrosive gases from boiler feed water in a cold condition. Contains diagrams showing various situations where the equipment has been used. Graphs the relationship between carbon dioxide, total alkalinity and pH value in the feed water.

158. Vinylite Finishes. The Watson-Standard Co., Pittsburgh, Pa.—Lists this company's series of high solids vinyl resins technical coatings for cans, closures, etc. Contains physical constants, suggested application methods and other data.

159. Motors. The Louis Allis Co., Milwaukee, Wis.—4-page leaflet describing this company's alternating current motor. Design and operating principles are shown by a sectional view of the motor. Presents graphs of speed regulation curves and performance curves.

160. Mixers. International Engineering, Inc., Dayton, Ohio.—24-page booklet describes and illustrates the propeller and turbine type mixers made by this company. Includes schematic drawings of their parts.

161. Equipment. Lee Metal Products Co., Inc., Philipsburg, Pa.—Bulletin LM-11. 4-page folder describing and picturing this company's cylinders for operating tilting kettles or agitators.

162. Cement Equipment. Hardinge Co., Inc., York, Pa.—4-page leaflet describing this company's equipment for various operations in cement processing work.

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Prepared by

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CHEMICAL ECONOMICS

H. M. Batters, MARKET EDITOR

PRODUCTION OF CHEMICALS THIS YEAR WILL SURPASS THE RECORD SET IN PEAK WARTIME YEAR

Winding up the year with a recovery from the dip reported for the third quarter, the chemical industry is establishing a new production record. Authority for this statement is found in the Federal Reserve Board indexes for production of industrial chemicals and in comparisons of specific outputs as reported currently by the Bureau of the Census.

Measured by Reserve Board indexes, the previous high for production was in 1944 when the monthly average was established at 403. Last year the average settled at 394 with approximately 434 indicated for 1947. Hence, the industry appears to have operated this year at a rate about 10 percent higher than in 1944 and between 7 and 8 percent above that of the record wartime year.

Monthly data on outputs of individual chemicals—largely from the Bureau of the Census—are less applicable on an industry-wide scale because the number of items included is limited and the rate of change is not uniform. However, on the list is a fair representation of the different branches of organics and inorganics and because actual tonnage figures are reported, exact comparisons are possible.

Largest tonnage chemical is sulphuric acid. Projecting the figures already at hand, gives an indicated production for this year of more than 9,800,000 tons of 100 percent acid, or not far from 1,200,000 tons more than was produced last year. On the same method of calculation, producers of soda ash appear to have been able to increase outputs by about 300,000 tons with nearly one-quarter of the increase coming from the natural product. Transfer of government plants to private operation helped in lifting chlorine production by about 200,000 tons, nearly all of the increase coming from the electrolytic branch.

Unusually high demand both for home and export, forced the utilization of a large part of installed ammonia capacity and production has run far ahead of that reached in any previous peacetime period. More than a million tons of the synthetic anhydrous product was made available or about 350,000 tons more than in the preceding twelve months. Near-capacity rates also were maintained at nitric acid plants with the result that the 1946 total was topped by around 270,000 tons. Increased outputs for other important inorganics include hydrochloric acid, 70,000 tons; salt cake, 100,000 tons; sodium phosphates, 20,000 tons; and silicate of soda, 45,000 tons.

From a percentage standpoint, many organic chemicals improved their position to a greater extent than was reported for the inorganics, which is in accord with the recent trend of a faster growth within the organic branch.

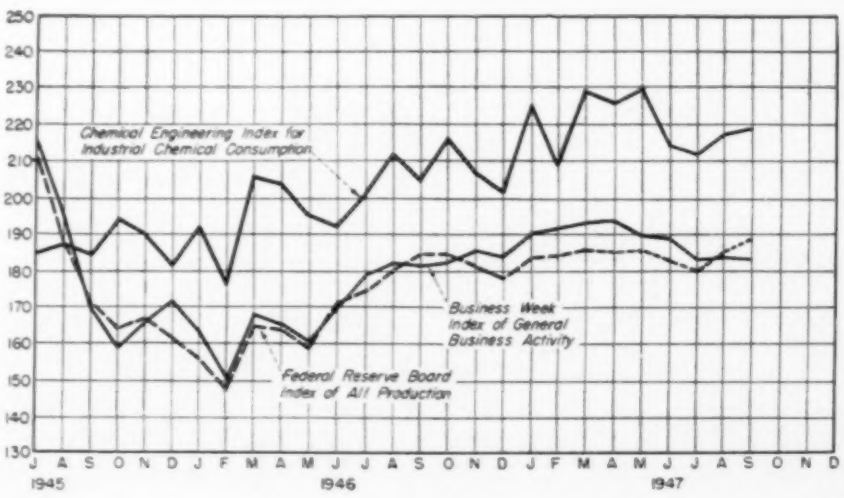
Chemical Engineering Index
Industrial Consumption of Chemicals
1935 = 100

	Aug. Revised	Sept.
Fertilizers	47.92	48.59
Pulp and paper	22.80	21.83
Petroleum refining	21.00	20.62
Glass	21.48	21.43
Paint and varnish	23.14	23.78
Iron and steel	13.30	12.42
Rayon	22.78	23.24
Textiles	10.22	10.40
Coal products	10.43	10.20
Leather	4.70	5.05
Explosives	7.79	8.16
Rubber	5.45	5.50
Plastics	6.40	7.40
	217.41	218.62

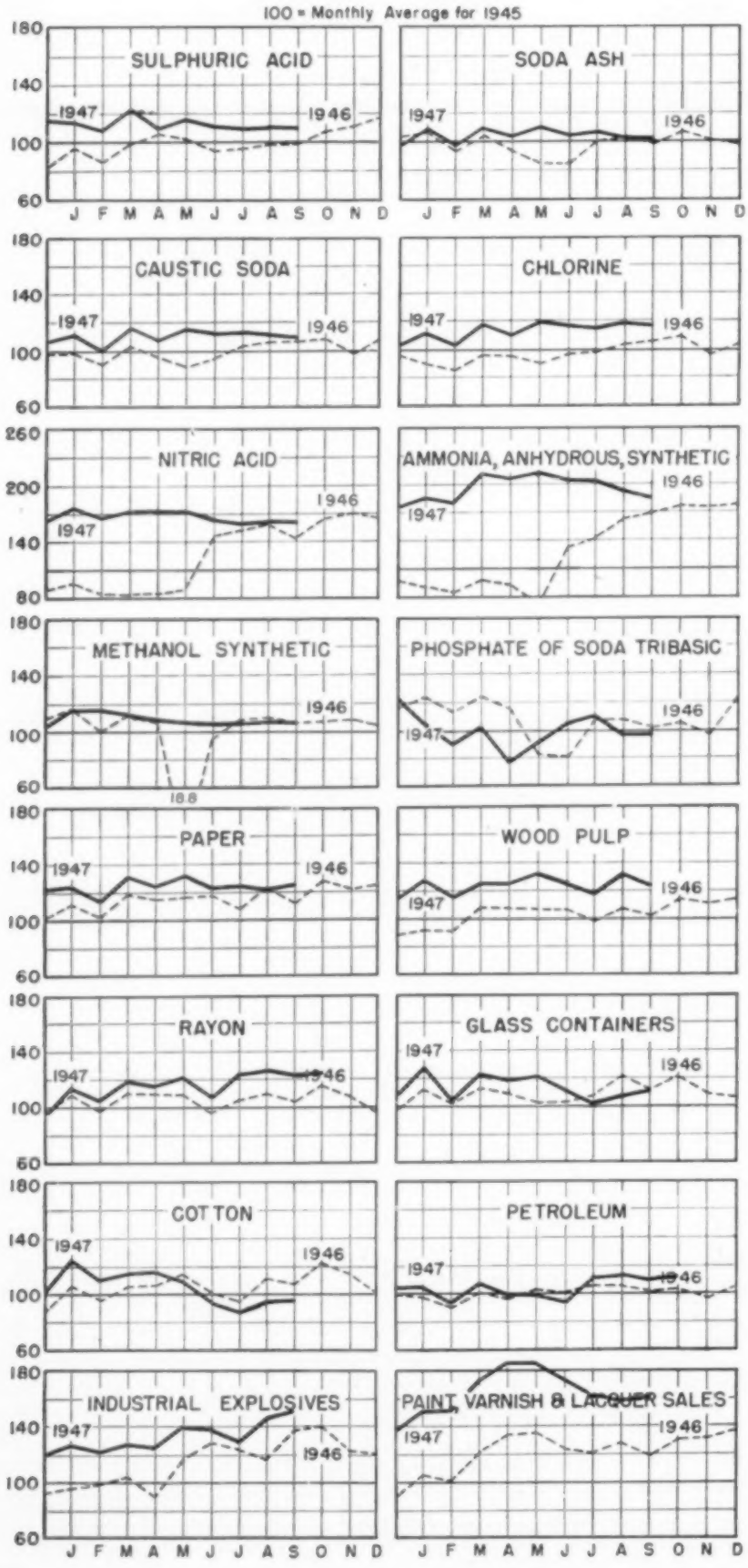
Compared with 1946, naphthalene, which still is on the list of scarce materials, moved up 23 percent. Production of synthetic acetic acid apparently will be around 377 million pounds or one-third more than the 1946 total. The supply of phenol turned out in the first nine months was almost equal to that reported for the entire twelve months of the preceding year, yet the indicated increase of 70 million pounds this year does not mean that supply has caught up with demand.

With chlorine more readily available, producers of chlorinated products were able to speed up activities as typified in the case of monochlorobenzene where an increase of 23 percent is indicated and in carbon tetrachloride, where the gain was 39 percent. Production of synthetic methanol undoubtedly would have been higher had not a part of capacity been taken out of operation early in the year, and this held the rise in output to 12 percent with a similar gain in the supply of formaldehyde.

Apparently there is enough momentum in such lines as building, automotive, steel, pulp and paper, chemicals, rayon, soap, and plastics to carry on at a rate at least equal to that held at present. In some fields signs of a levelling off have become apparent but there is nothing in sight upon which to base a belief that any sharp recession is in prospect for any line of manufacture where chemicals figure as important raw materials.



PRODUCTION AND CONSUMPTION TRENDS



TOTAL production of chemicals as reported monthly by the Bureau of the Census shows a slight drop in September from the preceding month but some of the individual chemicals bettered their August performance and in most other cases daily rates of operation represent a rise. Hence the upward trend of production which started in August was continued and from trade reports on the movement of materials and on activities in consuming lines, the upward pace was considerably accelerated in October with but little let down since then. Hence the final quarter of the year will show an improvement over the third quarter and may compare favorably with the high levels maintained in the first six months of the year. One of the unfavorable factors at present is scarcity of tank cars which is slowing down the incoming movement of raw materials and the outgoing movement of finished products.

Looking into the position of the individual chemicals, sulphuric acid is found to have been turned out at a rising daily rate in September and as new capacity is expected to be utilized in the closing months, prospects are bright for a large final-quarter output. Considerable new plant capacity for acid was added this year and announcements already have been made of prospective additions to be made in the coming year. Nitric acid has been affected by the large call for ammonium nitrate and if the still unused government ammonia facilities are put into operation, the outlet for the acid will be broadened accordingly. In addition to the old line companies producing hydrochloric acid, new sources of supply have sprung up as a result of recovery of the acid in the manufacture of many chlorinated products, the disappointing feature of this production being that some of it is in sections where consuming demand is limited.

Need for larger production of soda ash is seen from the fact that domestic consumers this year have faced a deficit of about 15 percent and it is difficult to estimate how much might have been exported had it been available. Additional production will come in at different times next year but earlier reports that supply will overtake demand by the middle of the year are now being modified and it is expected that ash and most of the other alkalis will be in short supply all through the year.

REVERE COPPER
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For Use With
LIQUID OXYGEN

★ ★ ★

COPPER and its alloys have long been favored by metal fabricators as materials of construction for pressure vessels, distillation columns, heat exchangers and other equipment for chemical plants. The ability of these alloys to be readily formed and easily joined by conventional methods, coupled with their good mechanical properties and high corrosion resistance, have made them preeminent in many applications.

However, the manufacturer of oxygen producing or handling equipment must consider more than the above-mentioned properties. He must insist that the materials used be immune to any adverse effects low temperatures may have. Many commercial alloys become increasingly brittle and lose their ability to withstand sharp blows as the temperature drops. But here again, there need be no worries with respect to copper and its alloys. Note the improvement at low temperatures in strength, ductility *and* resistance to impact for three copper base alloys:

Alloy (Annealed)	Temperature, °F.	Tensile Strength, psi.	Elongation, % in 2 in.	Impact Resistance—ft/lb, Izod Specimens
Deoxidized Copper	Room	31,400	48	43
	—292	58,000	58	50
Cupro Nickel, 30%	Room	70,800	41	90
	—292	112,700	51	97
Cartridge Brass, 70%	Room	51,100	49	66
	—292	73,500	75	79

(Tests on 0.25 in. diameter specimens)

Other Revere alloys, such as Herculoy (High-Silicon Bronze, A) show similar excellent properties at depressed temperatures.

Therefore, in designing oxygen plants, to play safe, specify copper-base alloys. Revere's Technical Advisory Service will be glad to assist in the selection of the proper alloys to meet your requirements.

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with SHRIVER Diaphragm Pumps

Some Users' Comments

● **On a very abrasive process fluid, "Our materials are hard to handle by ordinary pumps and maintenance costs have been high. Our Shriver Pumps have reduced these troubles greatly. We sent one of these pumps to our Brazilian plant where trouble-free operation is important because of lack of skilled mechanics."**

● **On formaldehyde, "Ours is a tough material to work with and the ready cleaning of the Shriver Pump, freedom from leaking and packing troubles are important to us. Our only charges so far have been for replacement of diaphragms." And that at minor expense.**

● **On saturated salt solution containing 40% metallic oxides, "It's the only type that will handle our sludges. High discharge pressure and resistance to corrosion and abrasion are important. Repairs and shutdowns are less and performance is better than for any other type we ever used."**

This Bulletin tells how such results are obtained. Write...

T. SHRIVER & COMPANY, INC.

802 Hamilton St. Harrison, N. J.

United States Production of Certain Chemicals

September 1947, September 1946 and Nine-Month Totals for 1947 and 1946

(Tons unless otherwise noted)	September 1947	September 1946	Total, Nine Months 1947	Total, Nine Months 1946
Ammonia, synthetic, anhydrous[1]	84,617	77,492	812,207	482,105
Ammonium nitrate (100%, NH_4NO_3)	83,041	73,730	779,999	455,849
Ammonium sulphate, synthetic, technical (M lb.)	32,173	27,658	289,164[3]	219,684
Calcium arsenate ($Ca_3(AsO_4)_2$) (M lb.)	3,107	2,608	39,775[3]	31,392
Calcium carbide, commercial	47,177	53,940	456,196	405,922
Calcium phosphate (M lb.)				
Monobasic (100%, $CaH_4(PO_4)_2$)	5,335	6,693	51,431	53,695
Dibasic (100%, $CaHPO_4$)	6,572	3,076	56,683	54,079
Carbon dioxide				
Liquid and gas (M lb.)	25,063	18,881	189,050[3]	165,798
Solid (M lb.)	77,347	59,905	578,625	502,407
Chlorine	116,451	104,206	1,023,288	857,189
Chrome green (M lb.)	1,035	1,121	10,103	13,968
Chrome yellow and orange (M lb.)	4,073	2,937	35,673	33,744
Hydrochloric acid (100%, HCl)	33,456	29,789	312,382[3]	248,328
Hydrogen (M cu. ft.)	1,981,000	1,620,000	15,537,000	13,030,000
Lead arsenate, acid and basic (M lb.)	.....	1,624	.....	46,817
Molybdate chrome orange	373	329	3,195	3,768
Nitric acid (100%, HNO_3)	59,900	54,136	562,677[3]	386,414
Oxygen (M cu. ft.)	1,092,000	997,000	10,015,000[3]	7,772,000
Phosphoric acid (50%, H_3PO_4)	88,035	73,795	760,222	652,144
Soda ash				
Ammonia-soda process				
Total wet and dry[3]	359,004	358,628	3,353,058	4,248,634
Finished light[3]	173,460	168,278	1,625,794	1,527,723
Finished dense	128,957	135,442	1,218,858	1,031,795
Natural[3]	25,992	17,742	205,232	154,652
Sodium bicarbonate, refined	13,310	16,558	147,516	141,124
Sodium bichromate and chromate	7,350	6,601	63,951	75,693
Sodium hydroxide				
Electrolytic process				
Liquid[3]	111,611	102,230	994,788	833,063
Solid	21,552	17,025	175,386	144,932
Lime-soda process				
Liquid[3]	58,511	62,422	562,670	553,756
Solid	19,480	19,606	183,875	164,945
Sodium phosphate				
Monobasic (100%, NaH_2PO_4)	1,189	1,057	10,698	8,852
Dibasic (100%, Na_2HPO_4)	7,254	4,840	50,311	43,092
Tribasic (100%, Na_3PO_4)	7,361	7,599	65,121	70,965
Meta (100%, $NaPO_3$)	2,948	2,353	23,041	19,676
Tetra (100%, $Na_4P_2O_7$)	5,092	4,308	40,176	40,811
Sodium silicate, anhydrous	34,667	34,714	346,026	302,203
Sodium sulphate				
Anhydrous, refined	11,593	8,038	102,967	91,801
Glauber's salt[4]	15,405	13,455	146,323	121,806
Salt cake, crude, commercial[5]	50,390	43,891	465,721	392,038
Sulphuric acid[7]				
Chamber process	259,528	242,657	2,448,420	2,305,317
Contact process, new	536,114	467,524	4,917,985	4,058,301
Zinc yellow (zinc chromate) (C.P.)	275	235	2,456[3]	.....

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades, excludes spent acid. [7]Data for sulphuric acid manufactured as a byproduct of smelting operations are included. [8]Revised.

United States Production of Certain Synthetic Organic Chemicals

August 1947, August 1946 and Eight-Month Totals for 1947 and 1946

Chemical	August 1947	August 1946	Total, Seven Months 1947	Total, Seven Months 1946
Acetanilid, technical and USP	434,895	493,197	5,267,277	.....
Acetic acid:				
Synthetic[1]	32,845,382	24,383,068	249,201,160	181,626,750
Recovered	116,837,649	94,679,656	941,309,867	766,111,039
Natural[2]	2,159,029	2,676,437	16,639,725	17,903,062
Acetic anhydride[3]	52,518,032	39,954,493	403,221,864	340,658,412
Acetone	36,023,949	30,016,254	280,000,612	215,463,981
Acetylsalicylic acid	1,125,609	459,677	9,255,510	6,593,657

(*Continued on page 302*)

MATERIALS of CONSTRUCTION

for Chemical Engineering Equipment

★ Copies of *Chemical Engineering's* Twelfth Report on Materials of Construction are now available. This 96-page booklet gives data on 58 materials used in the process industries. It also includes an article on corrosion problems of the Oak Ridge atomic plant and 8 pages of data and information on gaskets and packings..... **$1**

Editorial Department

CHEMICAL ENGINEERING ● 330 West 42nd St., New York 18, N. Y.

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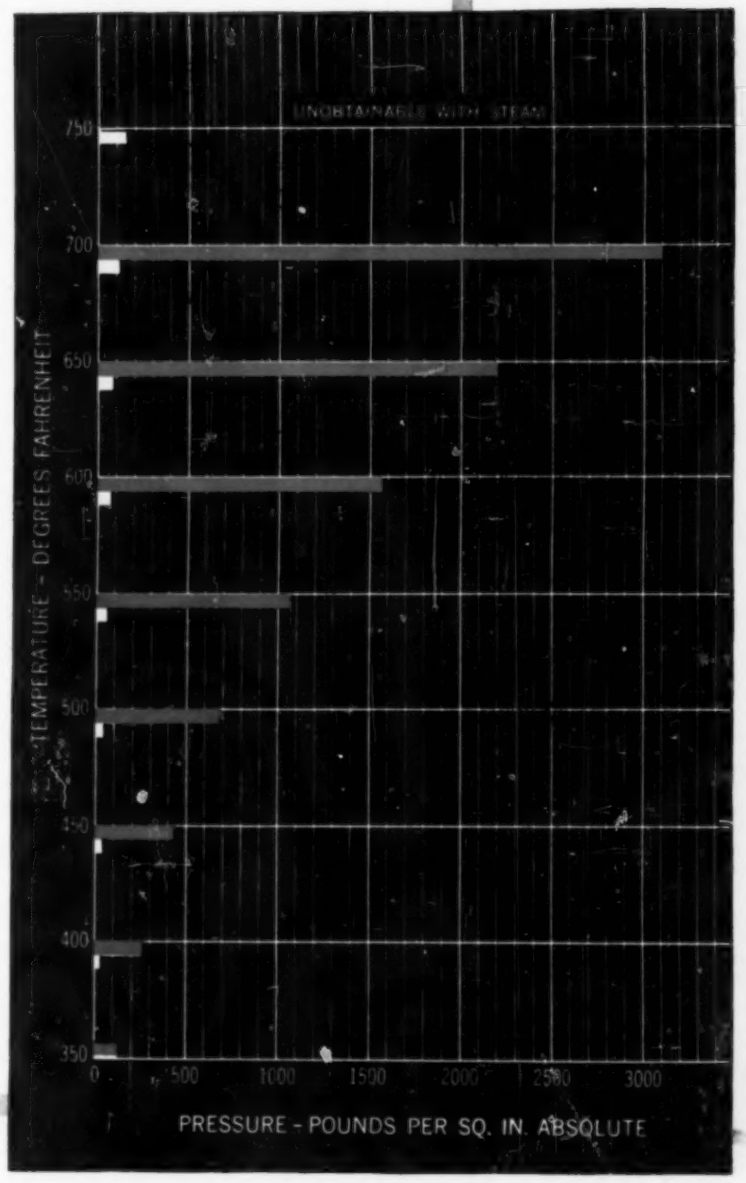

TEMPERATURE-PRESSURE COMPARISON
Dowtherm ▭ Steam ▬

This chart gives a direct comparison between pressures in FW Dowtherm heating systems and those encountered in steam systems for the same working temperatures.

FOSTER WHEELER

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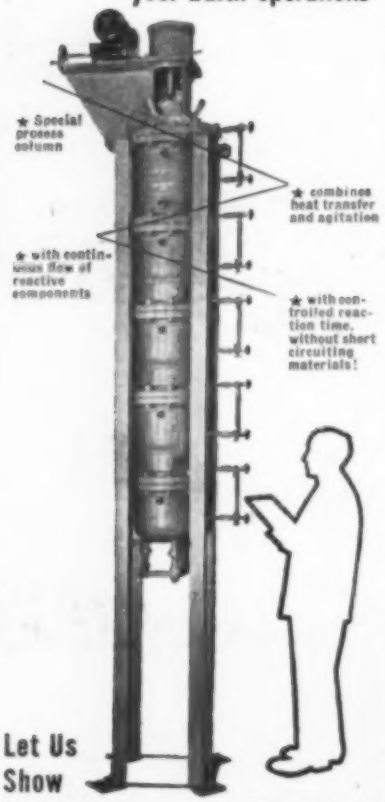
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"Special and Standard Process Equipment Engineered to Your Requirements"

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WEST NEW YORK, N. J.

U. S. Production of Synthetic Organic Chemicals (Cont. from page 300)

Chemical	August 1947	August 1946	Total, Seven Months 1947	Total, Seven Months 1946
Aniline	8,920,908	8,326,193	70,284,220	57,956,024
5-Ethyl-5-phenylbarbituric acid and salts (phenobarbital)	30,711	27,310	295,830	261,026
Benzene:				
Motor grade:				
Tar distillers[4]	.....	526,022	.....	6,404,407
Coke-oven operators[5]	761,111	3,220,789	13,016,009	20,083,592
All other grades:				
Tar distillers	.....	1,142,284	.....	14,628,252
Coke oven operators	10,996,105	10,617,860	94,509,337	63,771,444
Butyl alcohol, normal, primary	12,652,412	13,307,803	86,688,250	74,339,478
Carbon bisulphide	29,501,472	24,117,958	230,510,158	194,080,172
Carbon tetrachloride	17,630,932	13,474,610	133,048,936	92,659,449
Chlorobenzene, mono	27,869,532	22,157,017	215,363,668	177,003,943
Creosote oil:				
Tar distillers[4]	8,446,118	9,144,231	.....	73,719,895
Coke-oven operators[5]	3,541,660	2,591,878	25,307,988	18,235,25[illegible]
Cresols:				
Meta-para	570,400	977,008	4,103,899	3,579,870
Ortho-meta-para	844,249	739,052	6,457,998	.....
Cresylic acid, refined[7, 10]	2,356,728	2,339,110	17,696,394	14,809,664
Dibutyl phthalate	2,011,243	1,329,821	14,597,301	.....
Dichlorodiphenyltrichlorethane (DDT)	4,066,918	4,020,189	36,028,720	20,446,617
Ethyl acetate (85%)	5,899,025	8,121,628	55,790,146	59,913,890
Ethylene glycol	20,358,381	.....	.....	.....
Ethyl ether	2,611,072	3,885,867	28,065,858	27,289,304
Formaldehyde (37% by wt.)	38,719,233	38,149,391	348,866,658	300,554,612
Hexachlorocyclohexane	878,836	.....	3,274,021	.....
Methanol:				
Natural[8]	1,291,640	1,303,844	10,646,537	10,497,441
Synthetic	44,542,406	45,305,406	368,846,231	316,573,166
Naphthalene:				
Tar distillers, less than 79°C.	17,283,477	16,177,971	.....	118,886,979
Tar distillers, 79°C. and over	6,398,398	7,501,829	77,094,177	63,228,076
Coke-oven operators, less than 79°C.	8,344,619	7,771,396	63,823,248	41,294,986
Penicillin[9]	3,228,667	2,100,362	23,272,713	16,884,094
Phenol, synthetic and natural	23,588,542	14,812,191	171,431,146	129,129,632
Phthalic anhydride	12,396,166	8,466,960	91,388,587	68,504,281
Streptomycin	874,435	.....	.....	.....
Styrene, government owned plants	21,254,575	33,200,339	202,526,502	250,003,647
Toluene, coke-oven operators	2,248,735	1,255,713	27,310,166	10,500,243
Toluene, all other[9]	4,044,578	1,482,622	21,427,687	9,107,733
Xylene, crude, from coal-tar and petroleum	2,293,067	.....	.....	.....

All data in pounds except benzene (gal.), creosote oil (gal.), toluene (gal.), xylene (gal.) and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1]Excludes the statistics on recovered acid. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic by vapor-phase process. [4]Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene produced from petroleum by any process. [10]Includes refined cresylic acid from petroleum.

BURNS THERMALO

FLAMMABLE VAPOR DETECTOR

★ Electrical.
★ No glowing filaments.
★ Non-aspirating (in most applications).
★ For fixed installations or portable use.

• Are flammable vapors *normally* present in any of your processing, storage or handling operations?

If the answer is 'yes,' this new Flammable Vapor Detector *measures the margin of safety* continuously, to permit maximum production within safe limits.

• Can flammable vapors *accumulate* by accident or carelessness at any point in your plant or delivery facilities (including ships or carriers)?

If so, the instrument gives instant warning of the approach of a dangerous condition.

Write us your problem.

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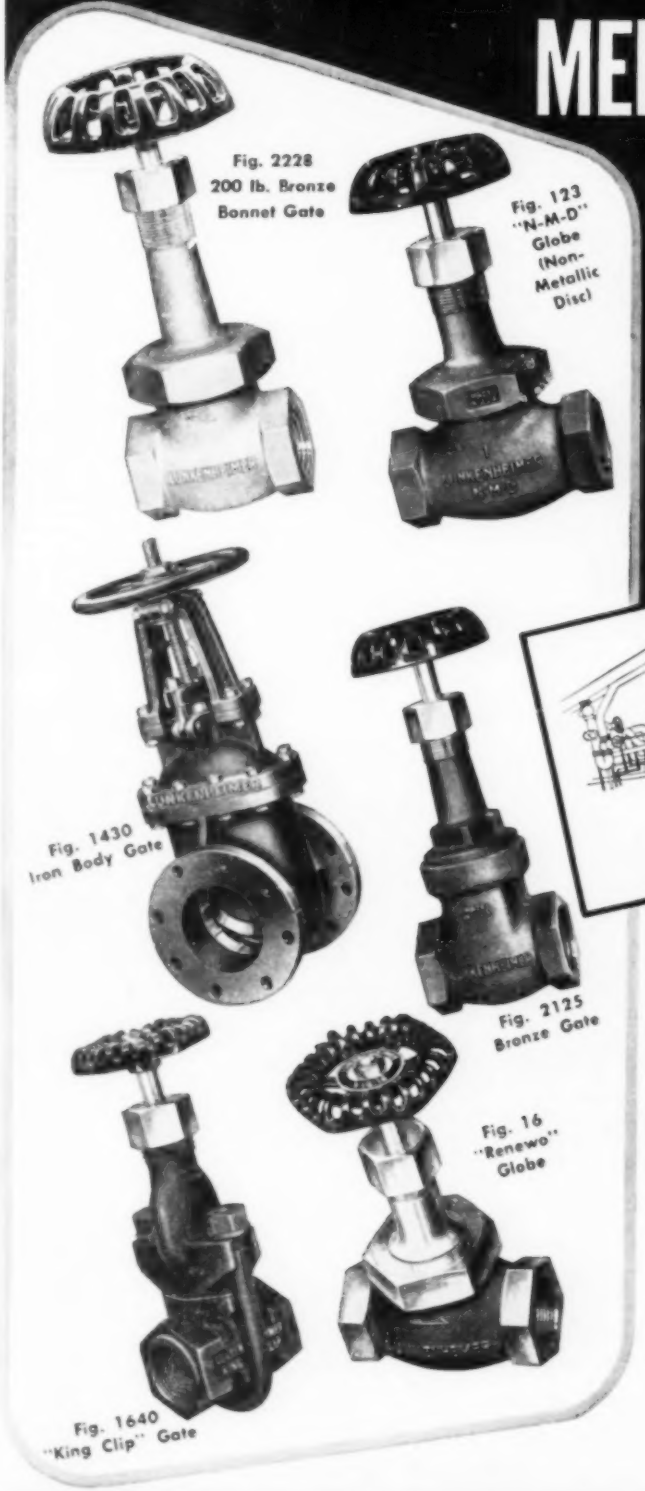
600 W. 43rd Street • New York 18, N. Y.

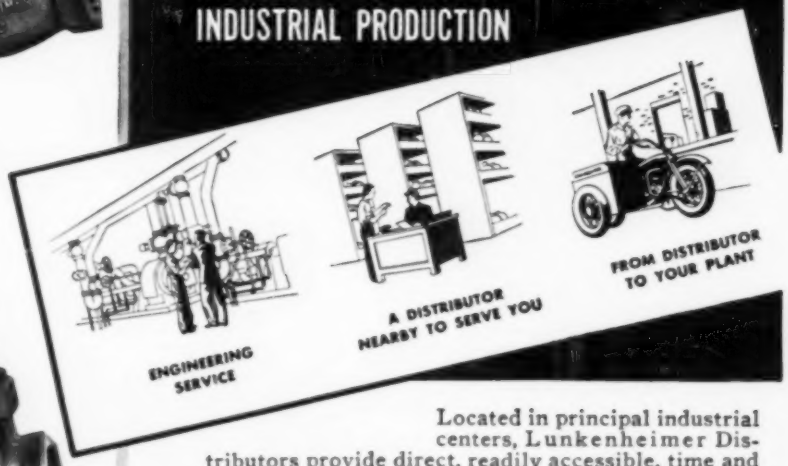
DETECTS . . . REPORTS . . . MEASURES . . . ACTS!

Relied upon BY VALVE MAINTENANCE MEN EVERYWHERE . . .

LUNKENHEIMER DISTRIBUTORS

RENDER A SERVICE THAT IS ESSENTIAL —A VITAL LINK IN THE CHAIN OF INDUSTRIAL PRODUCTION





Located in principal industrial centers, Lunkenheimer Distributors provide direct, readily accessible, time and money-saving service throughout the nation.

In addition to supplying high quality, long life Lunkenheimer Valves, they render valuable aid to maintenance men in the solution of both operating and maintenance problems.

This service is nothing new . . . Lunkenheimer Distributors have been providing it for many years in the past, and will continue doing so in the future. For this established Distributor set-up is a basic, permanent part of the Lunkenheimer way — the *better service* way.

Remember—you can *always* depend on your nearby Lunkenheimer Distributor for expert, willing assistance in any problem or difficulty involving valve maintenance or operation. Call on him!

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 34

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LUNKENHEIMER VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.;
BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

Even if you now use Industrial Trucks you may still cut handling costs!

Here's how one BAKER TRUCK *customer did it:*

In many plants Material Handling—like Topsy—just grew. Equipment for mechanizing individual handling operations was acquired piece-by-piece as needed. Although time and cost advantages were gained in each case, a lack of integration between departments usually prevented full realization of all the benefits possible.

Take the case of the Hammermill Paper Company in Erie, Pa. Their problem involved handling in process, storing, routing and loading an annual production well over 100,000,000 lbs. of some 3,000 kinds, sizes and colors of paper. Each department had its own electric trucks—and controlled its own handling operations.

Two years ago, after extensive study by its engineers, the company incorporated all trucks and handling personnel under one department, headed by a qualified expert who administered

Substantial savings were made by using a Baker Hy-Lift Truck with special tilt-type platforms for charging beaters with pulp.

details and expedited the material handling program. Immediate benefits were:

1. **Full utilization of trucks and personnel**
2. **More material handled with same equipment**
3. **Better maintenance of equipment**
4. **Improved transportation service in operating departments**
5. **Reduction in material handling costs**

A survey, after the new program had functioned for six months, showed that centralized, as against departmental control, resulted in the utilization of existing trucks to the best advantage in receiving, production, warehousing and shipping departments—providing maximum service at minimum cost.

The program had also resulted in the adoption of the pallet-fork truck method for handling raw, in-process and finished product. Materials such as clay, starch and talc are received in bags. Substantial savings were made by palletizing these bags on arrival and transporting unit loads by fork truck to storage and to production. Still further savings will come when all suppliers can be persuaded to ship material on pallets—negotiations for which are under way. It now takes about 14 hours to palletize a car of 1600 bags—weighing about 50 lbs.—but when material arrives already palletized unloading and warehousing can be completed in about 2 hours per car.

Palletizing also resulted in cutting unloading time of knocked-down shipping cartons from 24 hours per car, when they arrived loose, to approximately 3 hours, since they arrive in unit loads strapped to pallets, permitting fork-truck handling.

Additional benefits from centralized control of handling were reported when another survey was made at the end of 1946. Departmental superintendents, freed of material handling problems could now concentrate on production. Plant safety had been improved. Extension of mechanized handling eliminated much heavy manual labor—making these men available for higher paid, productive work. Work flow has been made more efficient and direct. With all handling under one control, proper allotment assures adequate equipment for all departments. Maintenance costs on trucks were lowered. The pallet-fork truck method, besides saving as mentioned, effectively solved the problem of handling a wide diversity of products and sizes of packages

Baker Fork Truck picking up unit load of lap pulp for loading into box-car for shipment.

Baker Fork Truck tiering pallet loads of bagged starch in storage. Note method of "locking" sacks to prevent side-slipping.

—incoming materials and out-going products.

A new warehouse, just completed, was designed around mechanized handling of unit loads. Tractor-trailer trains are assisted by fork trucks—permitting efficient, orderly storage, full utilization of space by tiering, and speeding order assembly for shipment.

Centralization of handling operations can be applied in large or small plants. If you want maximum benefits from your modern handling equipment, a Baker Material Handling Engineer can help you set up a central control in your plant.

See us at Booth 303
Materials Handling Exposition
Cleveland, January 12-16

BAKER INDUSTRIAL TRUCK DIVISION
of The Baker-Raulang Company
2145 WEST 25th STREET • CLEVELAND, OHIO
In Canada: Railway & Power Engineering Corp., Ltd.

Baker INDUSTRIAL TRUCKS

CHEMICAL ENGINEERING Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

As of December 1	128.52
Last month	128.40
December, 1946	121.23
December, 1945	109.08

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to December 1.

INDUSTRIAL CHEMICALS

Acetone, tank, lb	$0.07½ - $0.09
Acid, acetic, 28%, bbl., 100 lb	3.78 - 4.03
Boric, bbl., ton	124.00 - 142.50
Citric, drums, lb	.24 - .26
Formic, cbys., lb	.12 - .14
Hydrofluoric, 30%, drums, lb	.08 - .085
Lactic, 44% tech., light, bbl., lb	.0815 - .0855
Muriatic, 18%, tanks, ton	18.00 -
Nitric, 36°, carboys, lb	.05 - .05½
Oleum, tanks, wks., ton	19.50 - 20.00
Oxalic, crystals, bbl., lb	.13 - .14
Phosphoric tech., tanks, lb	.04 -
Sulphuric, 60°, tanks, ton	13.00 -
Tartic, powd., bbl., lb	.45½ - .48
Alcohol, amyl from pentane, tanks, lb	.17 -
Alcohol, butyl, tanks, lb	.17 - .30½
Alcohol, ethyl, denatured, No. 1 special tanks, gal	.96 -
Alum, ammonia, lump, lb	.04½ -
Aluminum sulphate, com. bags, 100 lb	1.15 - 1.25
Ammonia, anhydrous, cyl., lb	.16 - .20
tanks, ton	59.00 - 61.50
Ammonium carbonate, powd., casks, lb	.09½ - .10
Sulphate, wks., ton	35.00 - 38.00
Amyl acetate, tech. from pentane, tanks, lb	.21 -
Aqua ammonia, 26°, drums, lb	.03 - .03½
tanks, ton	65.00 -
Arsenic, white powd., bbl., lb	.06 - .07
Barium carbonate, bags, ton	67.50 - 75.00
Chloride, bags, ton	85.00 - 90.00
Nitrate, casks, lb	.11½ - .12
Blanc fixe, dry, bags, ton	67.50 - 72.50
Bleaching powder, f.o.b., wks., drums, 100 lb	3.75 - 4.00
Borax, gran., bags, ton	48.50 - 66.00
Calcium acetate, bags, 100 lb	3.00 -
Arsenate, dr., lb	09½ - .10
Carbide, drums, ton	70.00 -
Chloride, flake, bags, del., ton	21.50 - 38.00
Carbon bisulphide, drums, lb	.05½ - .06½
Tetrachloride, drums, lb	.06½ - .07
Chlorine, liquid, tanks, wks., 100 lb	2.25 - 2.50
Copperas, bgs., f.o.b., wks., ton	17.00 - 18.00
Copper carbonate, bbl., lb	.24 - .27
Sulphate, bags, 100 lb	7.60 - 7.75
Cream of tartar, bbl., lb	.38½ - .40
Diethylene glycol, dr., lb	.15 - .16
Epsom salt, dom., tech., bbl., 100 lb	2.05 - 2.25
Ethyl acetate, tanks, lb	.12 - .18
Formaldehyde, 30%, dr., wks., lb	.0545 -
Furfural, tanks, lb	.09½ -
Glaubers salt, bag, 100 lb	1.25 - 1.50
Glycerine, c.p., drums, extra, lb	.39½ - .45
Lead:	
White, basic carbonate, dry casks, lb	.15½ -
Red, dry, sck., lb	.176 - .18
Lead acetate, white crys., bbl., lb	.19½ - .20½
Arsenate, powd., bags, lb	.21½ - .22
Lithopone, bags, lb	.06 - .06½
Magnesium carb., tech., bags, lb	.07½ - .08
Methanol, 95%, tanks, gal	.60 -
Synthetic, tanks, gal	.24 - .29
Phosphorus, yellow, cases, lb	.22 - .25
Potassium bichromate, bags, lb	.11½ - .11¾
Chlorate, powd., lb	.09 - .09½
Hydroxide (caustic potash) dr., lb	.0785 - .09½
Muriate, 60%, bags, unit	.37½ - .45½
Nitrate, ref., bbl., lb	.08½ - .12
Permanganate, drums, lb	.20½ - .21¼
Prussiate, yellow, casks, lb	.19 - .20
Sal ammoniac, white, casks, 100 lb	4.75 - 5.00
Salsoda, bbl., 100 lb	1.10 - 1.20
Salt cake, bulk, ton	20.00 - 25.00
Soda ash, light, 58%, contract, bags, 100 lb	1.30 -
Dense, bags, 100 lb	1.38 -
Soda, caustic, 76% solid, drums, 100 lb	2.85 -
Acetate, del., lb	.05½ - .06
Bicarbonate, bags, 100 lb	2.25 - 2.75
Bichromate, bags, lb	.09 - .09¼
Bisulphate, bulk, ton	20.00 - 24.00
Bisulphite, bbl., lb	.03½ - .04

CHEMICAL ENGINEERING
Weighted Index of Prices for
OILS & FATS

Base = 100 for 1937

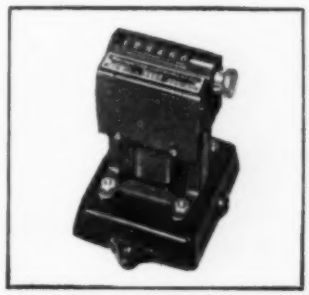
As of December 1	**309.01**
Last month	252.98
December, 1946	303.07
December, 1945	145.63

Chlorate, kegs, lb	$0.06½ –	$0.08
Cyanide, cases, dom., lb	.14½ –	.15
Fluoride, bbl., lb	.09½ –	.09½
Hyposulphite, bags, 100 lb	2.75 –	3.15
Metasilicate, bbl., 100 lb	3.40 –	4.00
Nitrate, bulk, ton	32.00 –	38.50
Nitrite, casks, lb	.06½ –	.07
Phosphate, tribasic, bags, 100 lb	3.50 –	4.00
Prussiate, yel., bags, lb	.12 –	.12½
Silicate, 40°, dr., wks., 100 lb	.95 –	1.00
Sulphite, crys., bbl., lb	.03 –	.04
Sulphur, crude at mine, long ton	16.00 –	18.00
Dioxide, cyl., lb	.085–	.09
Dioxide, tanks, lb	.044–	
Tin crystals, bbl., lb	.55 –	
Zinc chloride, gran., bbl., lb	.07 –	.07½
Oxide, lead free, bags, lb	.10 –	.10½
Oxide, 35%, leaded, bags, lb	.11½ –	.12
Sulphate, bags, cwt	4.15 –	7.00
OILS AND FATS		
Castor oil, No. 3 dr., lb	$0.28½ –	
Chinawood, oil, tanks, lb	.26½ –	
Coconut oil, ceylon, N. Y., lb	.26 –	
Corn oil, crude, tanks (f.o.b. mill), lb	.30 –	
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.28 –	
Linseed oil, raw, car lots, dr., lb	.336–	
Palm, casks, lb	nom.	
Peanut oil, crude, tanks (mill), lb	.30 –	
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	.28 –	
Menhaden, light, pressed dr., lb	.26 –	
Crude, tanks (f.o.b. factory), lb	.22 –	
Grease, yellow, loose, lb	.20½ –	
Oleo stearine, lb	nom.	
Oleo oil, No. 1, lb	.32 –	
Red oil, distilled, bbl., lb	.31 –	
Tallow, extra, loose, lb	.26½ –	
COAL TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.64 –	$0.66
Alpha-naphthylamine, bbl., lb	.35 –	.36
Aniline oil, drums, lb	.14 –	.15
Aniline salts, bbl., lb	.22 –	.24
Benzaldehyde, tech., dr., lb	.45 –	.50
Bensidine base, bbl., lb	.77 –	.78
Benzoic acid, USP, kegs, lb	.54 –	.56
Benzol, 90% tanks, works, gal	.19 –	.21
Benzyl chloride, tech., dr., lb	.20 –	.21
Beta, naphthol, tech., drums, lb	.23 –	.24
Cresol, USP, dr., lb	.14½ –	.15½
Cresylic acid, dr., wks., gal	1.25 –	1.30
Diphenyl, bbl., lb	.15 –	.16
Diethylaniline, dr., lb	.48 –	.50
Dinitrotoluol, bbl., lb	.18 –	.19
Dinitrophenyl, bbl., lb	.22 –	.23
Dip oil, 15%, dr., gal	.23 –	.25
Diphenylamine, dr., f.o.b. wks., lb	.25 –	
H acid, bbl., lb	.50 –	.52
Hydroquinone, bbl., lb	.90 –	.95
Naphthalene, flake, bbl., lb	.11 –	.11½
Nitrobenzene, dr., lb	.08½ –	.09
Para-cresol, bbl., lb	.41 –	.60
Para-nitroaniline, bbl., lb	.42 –	.43
Phenol, USP, tanks, lb	.11 –	.11½
Picric acid, bbl., lb	.30 –	.32
Pyridine, dr., gal	1.55 –	1.60
Resorcinol, tech., kegs, lb	.68 –	.70
Salicylic acid, tech., bbl., lb	.30 –	.35
Solvent naphtha, w.w., tanks, gal	.25 –	
Toluidin, bbl., lb	1.00 –	
Toluol, drums, works, gal	.23 –	
Xylol, com., tanks, gal	.26 –	
MISCELLANEOUS		
Casein, etch., bbl., lb	$0.30 –	$0.34
Dry colors:		
Carbon gas, black (wks.), lb	.04 –	.07
Prussian blue, bbl., lb	.42 –	.43
Ultramarine blue, bbl., lb	.13 –	.24
Chrome green, bbl., lb	.32 –	.42
Carmine red, tins, lb	5.50 –	6.00
Para toner, lb	.80 –	.95
Vermilion, English, bbl., lb	2.50 –	2.70
Chrome yellow, C. P., bbl., lb	.26 –	.28
Gum copal, Congo bags, lb	.09 –	.55
Manila, bags, lb	.09 –	.15
Damar, Batavia, cases, lb	.10 –	.22
Kauri, cases, lb	.18 –	.60
Magnesite, calc., ton	52.75 –	57.00
Pumice stone, lump, bbl., lb	.05 –	.07
Rosin, H., 100 lb	10.15 –	
Shellac, orange, fine, bags, lb	.61 –	.62
Bleached, bonedry, bags, lb	.64 –	.65
T. N. bags, lb	.59 –	.60
Turpentine, gal	.76 –	

Instantaneous Production Control With Improved Electric Counter

Accurate, up-to-the-minute counting of the production on this Davidson Folding Machine is done with the WIZARD Electric Counter.

New opportunities for more efficient production and elimination of over-run waste are created by WIZARD Electric Counters. These electrically-operated devices count any object or motion that will operate a switch, relay or photo-electric unit. Objects can be counted photo-electrically without physical contact and without risk to fragile or freshly-painted objects.



The Wizard Electric Counter

The Counters can be installed at any distance from the switch or photo-electric unit where the count originates. Or, they can be mounted on panels in the Production Department and arranged so that a production supervisor can maintain up-to-the-instant counts of all operations throughout the entire plant.

You can also count on chewing gum to help employee's on-the-job efficiency. Chewing gum helps relieve tension—keeps the throat moist—and prevents "false thirst" yet leaves hands free for work. That's why more and more plant owners are making Wrigley's Spearmint Gum available to everyone.

Complete details may be obtained from Production Instrument Company, 710 West Jackson Boulevard, Chicago 6, Illinois.

AB-80

NEW CONSTRUCTION

	Current Projects		Cumulative 1947	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$55,000	.....	$9,016,000	$2,784,000
Middle Atlantic	.....	$1,625,000	11,042,000	36,971,000
South	75,000	900,000	22,833,000	47,736,000
Middle West	230,000	1,250,000	16,822,000	23,709,000
West of Mississippi	27,530,000	998,000	302,667,000	140,685,000
Far West	100,000	1,500,000	5,406,000	18,454,000
Canada	.....	15,330,000	41,312,000	49,155,000
Total	$27,990,000	$21,603,000	$409,098,000	$319,494,000

Proposed Work

Calif., Burbank—Cinecolor Corp., Burbank, plans to construct a plant. Estimated cost $100,000.

Ill., Danville—Buhner Fertilizer Co., 219 Pearl St., Louisville, Ky., plans to construct a 1 story, 136x238 ft. plant here. Chemical Engineering Service, 225 Columbus Bldg., Green Bay, Wis., Engr.

Ind., Fort Wayne—U. S. Rubber Co., Fort Wayne, plans to construct three additions to its factory here. Estimated cost $175,000.

Kan., Topeka—Snyder Chemical Co. Bank of Topeka Bldg., plans to construct a 1 story, 80x120 ft. plant. Chemical Engineering Service, 225 Columbus Bldg., Green Bay, Wis., Engr.

Mass., Taunton—Geilich Tanning Co., West Water St., Taunton, plans to construct a tanning plant. Richmond & Goldberg, 16 Arlington St., Boston, Archts. Estimated cost $55,000.

N. C., Greensboro—Southern Oxygen Co., Washington, D. C., plans to construct a plant here. Estimated cost $75,000.

Okla., Maysville—J. E. Crosbie, Inc., National Bank of Tulsa Bldg., Tulsa, plans to construct a gasoline absorption plant here. Estimated cost $6,000,000.

Okla., Maysville—J. E. Crosbie, Inc., National Bank of Tulsa Bldg., Tulsa, plans to construct a natural gas gathering system from Antioch, North Elmore and Lindsay fields to Maysville. Estimated cost $275,000.

Tex., Borger—Alamo Refinery, Borger, plans to reconstruct portion of its acid refinery plant. Estimated cost $75,000.

Tex., Corpus Christi—Continental Oil Co., Oil & Gas Bldg., Houston, plans to construct a crude oil refinery and natural gas processing plant. Estimated cost $18,000,000.

Tex., Evadale—Champion Paper & Fibre Co., c/o Charles W. Dahney, Pres., Hamilton, O., plans to construct a paper mill in this area. Estimated cost $1,000,000.

Tex., Houston—Border States Distributing Co., 7431 Avenue B, plans to reconstruct a portion of its paint manufacturing plant. Estimated cost $60,000.

Tex., Nordheim—Wescol Oil & Gas Co., Nordheim and Corpus Christi, plans to construct a gas recycling plant. Estimated cost $1,300,000.

Tex., Orange—Texas Creosoting Co., Orange, plans to reconstruct a large portion of its creosoting plant. Estimated cost $125,000.

Tex., Texas City—Humble Oil & Refining Co., 1216 Main St., plans improvements to its refinery. Estimated cost $340,000.

Tex., Texas City—Republic Oil & Refining Co., Texas City, plans to improve and reconstruct its refinery. Estimated cost $300,000.

Contracts Awarded

Ala., Birmingham — American Rock Wool Co., c/o Rust Engineering Co., contractor, Liberty National Life Bldg., will construct a rock wool plant. Estimated cost $400,000.

Calif., Los Angeles—Longview Fibre Co., 4814 Loma Vista Ave., has awarded the contract for a 324x400 -ft. factory to W. P. Neil, 4814 Loma Vista Ave. Estimated cost $500,000.

Fla., Bartow—Armour Fertilizer Works, Bartow, has awarded the contract for the design and construction of a phosphate plant to Rust Engineering Co., Liberty National Life Bldg., Birmingham, Ala. Estimated cost $500,000.

Ill., Chicago—Darling & Co., chemical manufacturers, 4101 South Ashland St., has awarded the contract for remodeling its factory to Sill Construction Co., 6319 South Ashland St. Estimated cost $1,000,000.

Mo., St. Louis—Zonolite Insulation Co., 5100 Manchester Ave., has awarded the contract for a warehouse at 1515 Sulphur Ave., to G. L. Cousins Contracting Co., 875 North Skinker Blvd. 1 story, 40x340 ft.

Mo., St. Louis County—Missouri Portland Cement Co., Continental Bldg., St. Louis, has awarded the contract for a rock crushing plant for cement manufacturing on Highway 99, to H. A. Dailey, Inc., 870 Hodiamont Ave., St. Louis; also a clinker and lime storage building on St. Cyr Ave., to Fruin-Colnon Contracting Co., 1706 Olive St., St. Louis.

O., Toledo—Gulf Oil Corp., 435 7th Ave., Pittsburgh, Pa., has awarded the contract for improvements, additions and alterations to its plant to A. Bentley & Sons, 201 Belmont Ave., Toledo. Estimated cost will exceed $250,000.

Pa., McKees Rocks—Gordon Lubricating Co., Carnegie, has awarded the contract for an oil and grease plant here to H. H. & J. M. Boor, 1st and Pennsylvania R. R., Carnegie. Estimated cost $125,000.

Pa., Morrisville—Victor Chemical Works, 141 West Jackson Blvd., Chicago, Ill., has awarded the contract for a 2 story 100x100 ft. processing plant to Wininger & Shelby, Inc., 10 Rockefeller Plaza, New York, N. Y. Estimated cost $1,500,000.

Tex., Anson—Manley Bros., Anson, will construct a gas compressor station near here. Work will be done by force account. Estimated cost $85,000.

Tex., Houston—Gulf Chemical Co., Galena Park, has awarded the contract for the construction of a warehouse, Unit 1, to R. P. Farnsworth & Co., Inc., Bankers Mortgage Bldg., at $78,426.

Tex., Houston—Houston Natural Gas Corp., Petroleum Bldg., has awarded the contract for eight plant buildings to Southwestern Construction Co., P. O. Box 1204. Estimated cost $300,000.

Tex., Texas City—Petrol Terminal Corp., Texas City, has awarded the contract for improving and modernizing its gasoline plant to Catalytic Construction Co., Texas City. Estimated cost $225,000.

Tex., Texas City—Stone Oil Co., Texas City, will construct a storage building for oil products and materials and oil products pipe line in vicinity of refinery. Work will be done with company forces. Estimated cost $110,000 and $90,000 respectively.

Wash., Longview—Pacific Paperboard Co., Longview, will construct 100x400 ft. and 100x200 ft. buildings for newsprint mill. Work will be done by day labor. Estimated cost $1,000,000.

Que., Desbiens — At Raymond Paper Co., Desbiens, has awarded the contract for an addition to its digester plant to Art Construction, Ltd., 3 du Sacre Coeur St., St. Joseph d' Alma. Estimated cost $65,000.

Que., Gatineau Mills—Commercial Alcohols, Ltd., 3176 Notre Dame St., E., Montreal, has awarded the contract for additions and alterations to its plant to Anglin-Norcross Quebec, Ltd., 892 Sherbrooke St., W., Montreal. Estimated cost $130,000.

Que., Montreal, E.—British American Oil Co., Ltd., 866 Sun Life Bldg., Montreal, has awarded the contract for a fluid catalyst plant to Canadian Kellogg Co., Ltd., 8 Adelaide St., W., Toronto, Ont. Estimated cost $15,000,000.

Que., Montreal—Sherwin-Williams Co. of Canada, Ltd., 2875 Center St., has awarded the contract for a barrel storage and shipping building to Foundation Co. of Canada, Ltd., 1900 Sherbrooke St., W., Montreal. Estimated cost $60,000.

Que., Windsor Mills—Canada Paper Co., Ltd., Windsor Mills, has awarded the contract for a wood preparation building at its paper mill to R. E. Stewart Construction Co., 266 Wellington St., S., Sherbrooke. Estimated cost $75,000.

THE RUHR—
VALLEY OF DECISION

FOR AMERICANS and for American business the most important single spot on earth today is the Ruhr Valley of Germany—a valley no bigger in area than the State of Rhode Island. Upon recovery in the Ruhr hinges recovery in Europe. Upon recovery in Europe hinges the peace of the world.

No machine can run with its most important part missing. Western Europe without the Ruhr is a dead machine. Before the war, over half the coal and steel produced in the Western part of Continental Europe came from this one little valley. Today, the fact is that no other region in Europe has the technical skills and enterprise to produce the industrial supplies which Europe must have if it is to help itself back to a self-supporting economy. And, after observing Europe for many weeks, I am convinced that no one but the United States can successfully supervise the rebuilding of the Ruhr.

If you will keep four considerations in mind, as the international politicians gamble, you can easily tell whether the United States is playing its proper role in the rehabilitation of the Ruhr. Here are the four considerations:

I. We are paying for the Ruhr rehabilitation (or the lack of it).

II. We alone have the skill and enterprise to supervise its rebuilding.

III. It will be a tough organizing job requiring money, hard work, and outright sacrifice on the part of management men and technicians.

IV. We had better do it well if we love our children.

I

We are paying for rebuilding the Ruhr—or we soon shall be. The British now control the Ruhr, its government and its industry. They have been paying out about four hundred million dollars—American dollars—a year to buy the food, raw materials and equipment needed to rebuild the Ruhr. The British must spend American dollars for these supplies because the supplies can not be bought anywhere but in America. Thus far the British have, in effect, obtained the dollars which they spend for the Ruhr by drawing them out of the $3,750,000,000 loan which we granted Britain last year.

Now the loan is fast running out. The British lack dollars and other assets. We must take over, directly or indirectly, the dollar expenditures for rebuilding the Ruhr. We shall pay for it. Therefore—

II

We should supervise it. The British have been running the Ruhr's industry. They might conceivably suggest to Washington that they continue to run it while we pay the bill. *That we should never agree to.* There is a sound old rule that he who pays the piper shall call the tune.

Perhaps we would not need to invoke that rule if the British had done a good job reviving the industries of the Ruhr. *They have done a poor job—physically and ideologically.*

The physical output of the coal mines and steel mills of the Ruhr in recent months was actually smaller than at the first of the year. Production of coal amounts to little more than half of the pre-war 127 million tons per year. Steel productions limps along at one-sixth of the pre-war rate—far below the volume permitted even under the present low level-of-industry plan for Germany.

Ideologically, the British Labor Government has tried to export to Germany the brand of socialism which is making such a dubious record at home. Foreign Minister Bevin—although he may now have misgivings about it—committed himself to nationalization of the Ruhr's coal and steel industries. British representatives have pushed hard to get General Lucius Clay, our able military governor in Berlin, to agree to socialization of the Ruhr. So far, he has resisted this pressure, but our State and War Departments and we as individuals must back him up to the limit if he is to continue to combat this pressure successfully.

Even if the British government were not socialist, there would be good reason for questioning the ability of Britain to rehabilitate the industries of the Ruhr. In recent generations, the British management class has shown itself more

interested in cartels, restricting output, and allocating markets, than in full-steam, ingenious enterprising production.

Certainly the British must remain full partners in the *political* administration of Germany. No one suggests anything else. However, their recent production record demands turning the job of revitalizing the Ruhr industries over to the nation which is paying the bill and which leads the world in production.

If we have any faith in the business philosophy by which we have lived and prospered for 170 years, we should demonstrate that that philosophy still is dynamic by taking up the burden of the Ruhr.

III

It will be a tough job. It will require men and supplies and money from the United States. It can not possibly be done in less than five years. A list of some of the necessary steps shows how hard it will be.

A. Plans for socializing the Ruhr should be shelved quickly. The industries there should remain in trusteeship for five years. Then the Germans themselves should decide their ownership; let us hope that by that time we can demonstrate to them that private ownership and private initiative mean high production, good distribution and high wages.

B. The top supervising management jobs—both the top policy and the top technical jobs—required outstanding business ability. That is why American business men must be willing to go to Germany, sacrificing comfort and leisure, and even income, if necessary.

C. Germans should take over the management job at the operating level. The Germans are good technicians. They have a greater incentive than anyone else for getting the Ruhr back in working order. That incentive should be harnessed.

D. Special effort should earn special rewards. There is nothing wrong with the Ruhr (or the rest of Europe) that hard work will not cure. Before a man will work hard, he must feel that his work will advance him and his family. That simple motive, which powers our whole economy, must be revived in the Ruhr. To revive it requires enormous ingenuity and work... a new currency... a logical customs union... a sensible ration system... enough food, clothing, housing and consumer goods so that the worker can buy something with his currency and his ration points.

E. America will have to furnish a good share of these foodstuffs and supplies. Certain key items of equipment also will be needed. Only as we succeed in our job can this flow be diminished.

F. A sensible priorities system must channel Ruhr coal and steel into those uses which, in turn, will further increase output. Repair parts for railroad cars should stand high on the list. Housing, coal equipment and machine tool parts should come ahead of the automobiles and permanent steel bridges which at times have been accorded preference.

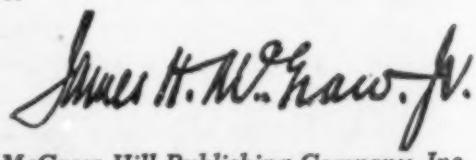
German technical management of industry in the Ruhr—point C above—need not mean *political* control of the Ruhr by some future sovereign German state. As the French know, the Ruhr, next to the atomic bomb, is the most dangerous weapon in the world. It is the arsenal without which no European power, even Russia, would dare start a war. There is no sense in turning that arsenal back to the *political* control of a nation which twice in 25 years used it for aggression. (And three times since 1870.) Surely we have enough resourcefulness to let the Germans who live in the Ruhr run the industries there without turning political control over to a central Prussian state.

This partial list shows how much hard work and statesmanship the United States must put into the Ruhr. But—

IV

We had better do it if we love our children. If we do not do this job—if we should pull out of Germany or fail there—we leave behind us a vacuum which neither Britain or France has the strength or ability to fill. Russia has the will and, if left unopposed, the power to fill that vacuum. Therefore, the day we fail or the day we pull out of Germany, the third world war takes a long step closer to us and certainly to our children. What greater incentive does any American need to work for than our success in this field?

If we succeed, the western zones of Germany in conjunction with Belgium and Holland can become self-supporting in three to five years. That way lies recovery for all Europe. That way lies peace for the world. That way lies vindication for the American business system in which we believe—the system of competitive private enterprise, with freedom for the individual and his initiative.



President McGraw-Hill Publishing Company, Inc.

THIS IS THE 60TH OF A SERIES

WHILE WE DELAY—

Russia Drives for the Atlantic

IN THE STRUGGLE to keep western Europe west of the Iron Curtain it is later than you think. Unless the United States quickly mobilizes its own and other nations' resources, World War II will be lost as World War I was lost—by no economic follow-through.

Millions of people in western Europe, living in cold homes or no homes at all, face another winter of near starvation. Some countries are absolutely without dollars to buy abroad the food and fuel they need for survival. Others slide toward that desperate state.

In this welter of misery Russia grasps for dominion over all Europe. Everywhere, as cold and hunger deepen and as men begin to doubt America's determination to help, Russia turns on the pressure. In France the Communists drive to overthrow the Government. In Italy they do likewise. In Greece Russia kills the United Nations investigating commission. In Trieste Tito elbows us out of the way. In Germany and Austria the Soviet commanders alternately stymie and flout the Allied governments.

FACED WITH this bloodless attack, the leaders of western Europe and of the United States have not covered themselves with glory.

Look, for example, at what the sixteen European countries participating in the Paris meetings on the Marshall "plan" first proposed to the United States as a catalog of their needs. In the main it was simply an adding up—to $30 billion—of what the various countries thought they needed to keep going in the same old way at the same old stands. There was no real start on plans for the mutual aid by European states which is the essence of a successful recovery program . . . no real start on plans to knock down the barriers which divide European trade into hopelessly inadequate little pockets . . . no real plans to clean up currencies which deteriorate so fast nobody wants to work for them. *In fact no plans to make people want to work.*

Meanwhile, what have our leaders offered? Not much more than one fine commencement speech by General Marshall, outlining a good idea, and a couple of carloads of statistics, with more to come.

Not even a beginning has been made on the most crucial part of any European aid program—*that of explaining to the American people what their part must be and why.* It is true that not all the reports of all the statistical committees have been completed. They never will be. But it is also true that the broad outlines of what the United States must do to save Europe are already clear. And it is not simply to provide more dollars, although $12 to $16 billion more—the cost of 6 or 8 weeks fighting in World War II—may be required.

A far more basic requirement is leadership which will lift Europe out of the slough of despair and get recovery rolling. Without that leadership more billions for Europe will buy us nothing but more bitterness and remorse on both sides of the Atlantic.

WHAT ARE the ingredients of that leadership? Here are a few:

1. A bi-partisan program for European recovery.

It should be so thoroughly understood and so overwhelmingly supported by both parties that playing politics with it will be like selling military secrets to the enemy.

Truman and Vandenberg have failed miserably to develop and explain a complete program—one in which Europe and America can have full confidence. Nor have Taft and Dewey and other candidates for high office pledged that politics will stop at our shoreline. These men must speak out. To date Herbert Hoover alone has had the courage and vision to state a program.

2. A mobilization of American food supplies.

We must assure people at home and abroad that our crops, cut down by drought and heat, will be stretched to cover minimum European needs (with whatever help we can muster from other nations) without forcing still higher food prices here.

Some food experts are comfortably confident that the stretching can be done. But

meatless and wheatless days, higher extraction of flour from wheat and similar voluntary conservation moves would make it surer. And they would demonstrate that a free country can mobilize itself to meet a very serious crisis.

3. An understanding that relief is one problem and recovery another.

Both problems must be solved. Relief emergencies must be met, some of them at once. But they must not black out the longer task of recovery. Italy illustrates the point. Italy, particularly the south, is flat broke. Help is needed right now to keep people from dying in the streets. But we must eventually do more than keep the Italian people alive. We must help them get back to useful work so that they can stand on their own feet.

4. A steady insistence on results—which means that Europe must find a way to make its people want to work.

In the U.S.S.R. they have a way to get things done. It is to liquidate those who do not work. In the U.S.A. we have a way to get things done. It is to create incentives to make people want to work. Western Europe, notably France and Britain, has fallen between two stools. It has socialized away the incentives, and it does not yet, thank heaven, enslave the laggards. We should make it crystal clear that we have no designs on the national "sovereignty" of others. But we should make it equally clear that we insist that those countries which receive our aid work hard enough to get results. To this end continued aid should be on an installment plan, each installment conditional on getting results. Otherwise more billions can easily disappear down the drain.

5. Insistence on all-out self-aid by European countries.

That is the constructive core of the Marshall idea—to help Europe to help itself. In his brilliant "Report on Germany" and how to get it "off the backs of the American taxpayer," Lewis H. Brown, Johns-Manville Chairman, shows how the export of only 10 million tons of coal a year from Britain to western Europe would speed industrial recovery of the Ruhr immeasurably. There are countless other cases where effort in one European country—or a group of countries—will break a big industrial bottleneck in another. We should insist that everything possible be done to see they are broken.

6. An agreement with Britain and France giving us authority in western Germany equal to our responsibility.

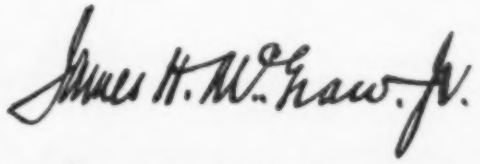
Britain is shifting to us most of the financial burden she has been carrying in the German occupation. Less directly we shall also be carrying much of the French occupation load too. We must have authority in the economic field commensurate with our responsibilities. Otherwise the management of western Germany can poison Anglo-American and Anglo-French relations in addition to wasting resources we could use to promote general European recovery.

It is truly said in the scriptures that the Lord loveth a cheerful giver. But it is not recorded anywhere that anyone, including the recipient, loves a soft-headed giver. Hence as a capstone any program of aid for Europe should have machinery assuring that only what is needed is sent; that what is sent does the job for which it is sent; and that arrangements are made for the recipients to pay back whatever they can.

THE AMERICAN PEOPLE should be told clearly by their leaders that there is no assurance that the best possible program of economic aid for Europe will do the job. The time is very late.

In France and Italy, as our help falters, the Communists right now are provoking strikes which will make the people's suffering more acute. They hope, of course, to overthrow the governments in both those countries and to seize control. If Communist dictatorships are clamped on France and Italy this fall, Russia and her satellites will have advanced to the Atlantic. The Iron Curtain will have moved 500 miles west—toward us.

Americans should be clearly told, therefore, that not to undertake an immediate program for the recovery of Europe is to bring closer the greatest possible national disaster—World War III.



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THIS IS THE 61st OF A SERIES

TAFT-HARTLEY ACT

Frees "Slave" Labor

THE TAFT-HARTLEY ACT is two months old. Its full meaning is yet to be determined by decisions of the National Labor Relations Board and the courts. However, on its face, the Act refutes the attacks made upon it by union leaders as hysterical and fanciful.

Management has had every provocation to reply to these attacks in kind. To the credit of the employers of this country, they have not succumbed to that temptation. They have maintained a temperate attitude toward the new law and the problems it is designed to correct. This approach is right. But it is only an approach.

Union leaders will want to settle for nothing short of *repeal*. Their attack on the Act has made some headway. It may be more effective as time goes on. *Certainly the Taft-Hartley law will be repealed if management just sits tight and lets union leaders continue to confuse their followers.*

Management, therefore, must implement its present temperate attitude with a program of positive action. The Taft-Hartley Act must be made to work not because management wants it, but because it is fair to labor — and management can do things right now to see that the Act works. Management can:

I. Utilize every means at its disposal to acquaint the rank and file of union workers with the truth about the Taft-Hartley Act.

II. Suggest amendments to the Act if experience indicates that amendments are necessary.

III. Use the law as little as possible in settling labor disputes.

IV. Stand firm in its refusal to bargain away the rights accorded by the Act to workers, management, and the public.

An examination of those four *must's* will show why they provide management with its best program of action.

I.

Union members do not know what the Taft-Hartley Act provides.

There is abundant proof of that statement.

While Congress was still trying to write a law that the President would not veto, FACTORY magazine asked workers how they felt about major proposals in the pending House and Senate bills. Overwhelmingly they felt good. They were in favor of almost every individual provision that was finally incorporated into the bill and passed over the President's veto.

The same story emerged from the national opinion poll made by the Opinion Research Corporation of Princeton, N. J. and published by Look magazine after the law was enacted. It showed that union members uniformly favored major provisions of the Act, but were strongly opposed to the Act itself.

This inconsistency is easily explained. Instead of telling their members what the Act does for them, most union leaders have been condemning it as "a slave labor law" because it curtails the leaders' power and recognizes the rights of the union member and the public.

It is not a slave labor law. All of the basic rights accorded to labor by the Wagner Act of 1935 are preserved by the Taft-Hartley law. All of the unfair labor practices that were forbidden by the Wagner Act are still forbidden by the Taft-Hartley Act.

Nothing in the law impairs labor's right to bargain through representatives of its own choosing.

The Wagner Act condemned as an unfair labor practice any effort by employers to coerce employees in the selection of their bargaining representatives. So does the new law.

The Taft-Hartley Act merely recognizes rights of individual employees, of management, and of the public that were ignored by the Wagner Act.

For example, while the Taft-Hartley Act continues the workers' protection from coercion by employers, it also gives them new protection against coercion by unions. The individual worker is freed from the necessity of joining a union to *get* a job. He may still be required to join a union to *keep* his job, but not unless a majority of the workers vote for such a requirement in a government-supervised election.

Some people think the Taft-Hartley Act is weak in protecting the rights of the individual worker. They think that membership in a union should never be made a condition for holding a job. This is true. However, the Act does restore to the individual worker some rights which were blotted out under the Wagner Act, just as it does to management and the public.

A fair examination of the new law's provisions will show that they spring from one dominating purpose: i.e., to re-establish equality before the law.

For example, under the Wagner Act union leaders were free to say whatever they pleased about the employer to his employees. The employer, on the other hand, was denied freedom of speech in talking to his own employees. Now freedom of speech is largely restored.

Under the Wagner Act the employer was compelled to bargain with a certified union. Now the union must bargain, too.

Under the Wagner Act, unions alone had the right to petition for an election to determine whether the petitioning union represented a majority of the workers. Now the employer also has the right to secure an election.

These are features of the new Labor law that management must help workers understand. They must understand why the Act is not the "diabolical monstrosity" Philip Murray tells them it is.

Some companies have already started to explain these things to their workers. Techniques are well established, and they are techniques that any company can use. They include labor law digests in language workers can understand, supervisory conferences to cover points in the Act that affects the supervisor's handling of his job, distribution of reprinted articles that point out how employees benefit from the new law, editorials in plant newspapers and magazines, and advertisements in local newspapers.

II.

Management should take the lead whenever amendments to the Taft-Hartley law become necessary.

For twelve years labor leaders wilfully opposed every attempt to correct obvious abuses in the Wagner Act. We have now proved that a labor law *can* be amended. Let us be sure that management does not resort to the same obstructionist tactics labor has always used.

In carrying out its basic purpose to re-establish equality before the law, the Taft-Hartley Act makes it "unlawful . . . for any corporation whatever or any labor organization to make a contribution or expenditure in connection with" national elections. Corporations have long been so restrained. The novelty is the balancing restraint upon unions, which now have huge financial resources amounting to very many millions of dollars. However, the language of the Act *may* restrain the labor press from saying what it thinks about candidates, thus impinging upon the freedom of the press. Senator Taft has recognized this possibility.

If it should develop that the Act inadvertently throttles freedom of the press—or misfires otherwise—management should take the lead in securing suitable amendments to the Act. By assuming a completely stiff-necked attitude toward any and all changes in the Wagner Act, no matter how badly needed, the dominant labor leaders and their political outriders finally brought on the sweeping revisions provided by the Taft-Hartley Act. Management must not follow that example of stupid leadership.

III.

Management will be wise if it uses the new law gently in settling labor disputes.

So far employers show no disposition to use the law excessively. That is good. An analysis of the NLRB's docket from August 22 to September 30 shows that approximately 90 percent of the cases now before the Board were filed by unions and employees — not by employers.

We have been surveying employers, asking if they will have occasion to use their right to sue their unions. The answer so far is consistently, "*no.*" That answer frequently is accompanied by this remark, "We certainly hope not. We have no desire to conduct our labor relations in the courthouse."

The desired result should be for the Act to produce only those law suits that are matters of vital principle. As many employers have remarked, the courthouse remains the worst possible place to conduct labor relations. The best place is in the plant—by free collective bargaining between parties enjoying an equality before the law. The Taft-Hartley law will serve its most constructive role if it encourages this kind of collective bargaining.

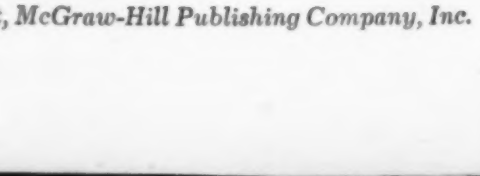
IV.

Employers should not bargain away legal rights accorded to them by the Taft-Hartley Act.

By bargaining away rights given them in that Act, employers serve only to upset a carefully created balance of equality before the law which is an essential element of fair collective bargaining.

Also, by bargaining away rights properly accorded to them, they let down those members of Congress who, in voting for the Act, braved continuous threats of political assassination by powerful union leaders. For their statesmanship in the complicated field covered by the Taft-Hartley Act these Congressmen deserve the support and gratitude of the whole nation—of management, of labor, and of the public alike.

Fairly handled on all sides, the corrective force of the Act can be made a major bulwark of industrial freedom.



President, McGraw-Hill Publishing Company, Inc.

POLITICAL ACTION—
Labor's Blind Alley

THE approach of the 1948 elections brings organized labor in America to a fork in the road.

Straight ahead lies the familiar route of free collective bargaining. Except for an occasional side trip, labor has been traveling it for years. On this road the role of government is to act as traffic cop, removing obstructions for all travelers.

The fork is the road of political action—the road to special privilege for labor. On it government is called upon to clear a special right of way for organized labor—to push aside all others.

Which of these two roads will organized labor take?

Most American labor leaders are now urging their followers toward political action. Their first objective is to "get" all members of Congress who voted for the Taft-Hartley Act. AFL plans to raise a $5 million political combat fund through contributions and a per capita tax on its membership. CIO is soliciting $1 donations for political action from its 6,000,000 members.

For their own sake, however, as well as for the welfare of the country as a whole, the rank and file of organized labor will do well to stop, look and listen before they turn their unions into political action squads. If they examine the facts for themselves, they will make two significant discoveries:

I. Political action is a blind alley for labor.
II. The Taft-Hartley Act is an essential bulwark of free collective bargaining.

A brief discussion of these two statements will show what they mean to organized labor.

I

Political action is a blind alley for labor.

If there is any doubt about that statement, a good way to dispel the doubt is to look at European countries where organized labor has been following a political action line.

Britain, where the Labor Party is in power, is such a country. How is labor faring there? Measured by the good things money buys, the average hourly wage in Britain is less than two-thirds of what it is in the United States. Part of the difference may be accounted for by the fact that the British Isles are poorer in natural resources than the United States. Another reason is the war damage to Britain's plants.

But there are two other big reasons why the British wage earner is far behind the American worker in enjoying the good things of life:

1. The *incentive to produce* has been dulled by vote-catching programs which promise economic security and a levelling of incomes. Lulled by promises of cradle-to-the-grave security and discouraged by high taxes, the British have descended to a state neatly described by the London *Economist:*

"Nobody gains anything from activity or suffers anything from inactivity."

2. To run a program like Britain's requires more and more government functionaries. Civilian employees of the British government have increased by 50% since before the war, putting one worker out of ten on the government payroll. More and more people stop producing and spend their time instead cutting up what others produce. The result is smaller production, higher taxes and lower real wages.

The British Labor Party must accept most of the responsibility for this sorry state of affairs. It is due primarily to a program of political action by organized labor which promised the individual worker security and equality of income—*but which can not deliver either because the incentive to work is gone.*

The lesson for American wage earners is clear. Political action by unions to enforce the economic fallacy of more-and-more-for-less-and-less will end by impoverishing the working man—and bringing the nation to ruin.

Unions exist for collective bargaining, not for politicking.

II

The Taft-Hartley Act is an essential bulwark of free collective bargaining.

Bargaining works satisfactorily only when both parties—management and labor—think they are getting a fairly even break.

Management was very sure that the Wagner Act, as administered from 1935 to 1947, was giving employers the short end of the stick. Furthermore, management's feeling of frustration was no whim. It was justified by case after case where rights were granted to organized labor with no counterbalancing recognition of the rights of management, of individual workers or of the public.

The Taft-Hartley Act goes a long way toward establishing equality in employer-union relations. It may fall short of doing a perfect job. *As a subsequent editorial in this series will show, it leaves virtually untouched the public menace of industry-wide bargaining and labor monopoly. And it leaves unprotected what should be the individual's right to hold a job without joining any particular organization.* But it *does* provide some major safeguards for collective bargaining by striking at abuses.

Organized labor, therefore, has no cause to damn the members of Congress who voted for the Taft-Hartley Act. True, the law will check what has been an uninterrupted march of the labor union bosses toward absolute power. It will do so just as laws in the past—The Sherman Anti-Trust Act, for example—have checked management when it was too greedy. And, as the first section of this editorial points out, the time has come to check the march of the big labor bosses.

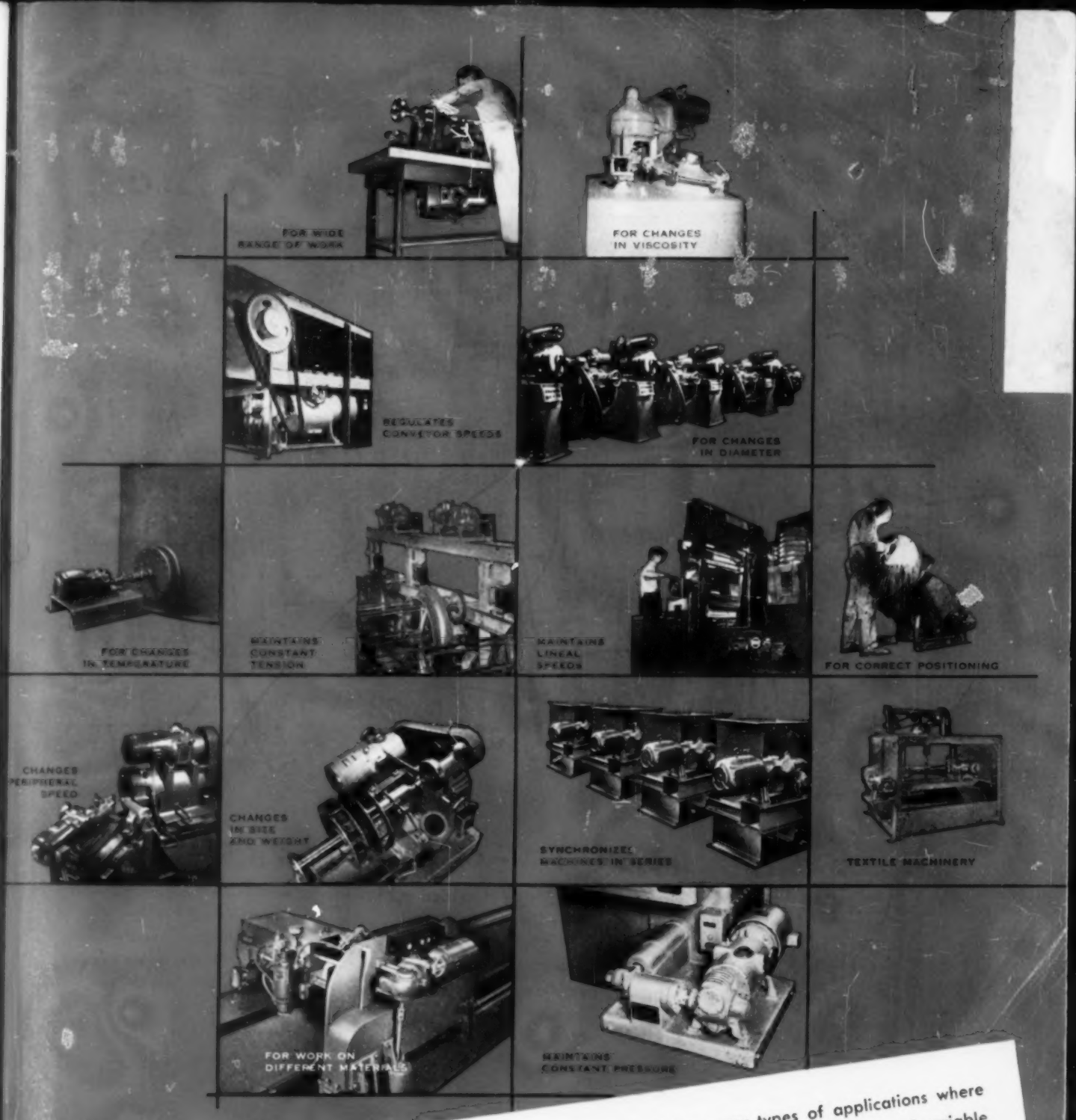
Fundamentally, the Taft-Hartley Act gives free collective bargaining a new lease on life. The old lease was running out because the Wagner Act stacked the cards against employers, against individual workers, and against the public.

The road to free collective bargaining is now clear of many of the most menacing obstructions. It is the only road for labor to take in its own self interest. Union workers who let their leaders lure them down the blind alley of political action will do so at their own peril—and at the peril of this great industrial nation.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

THIS IS THE 63RD OF A SERIES



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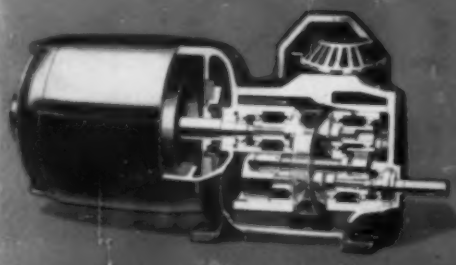

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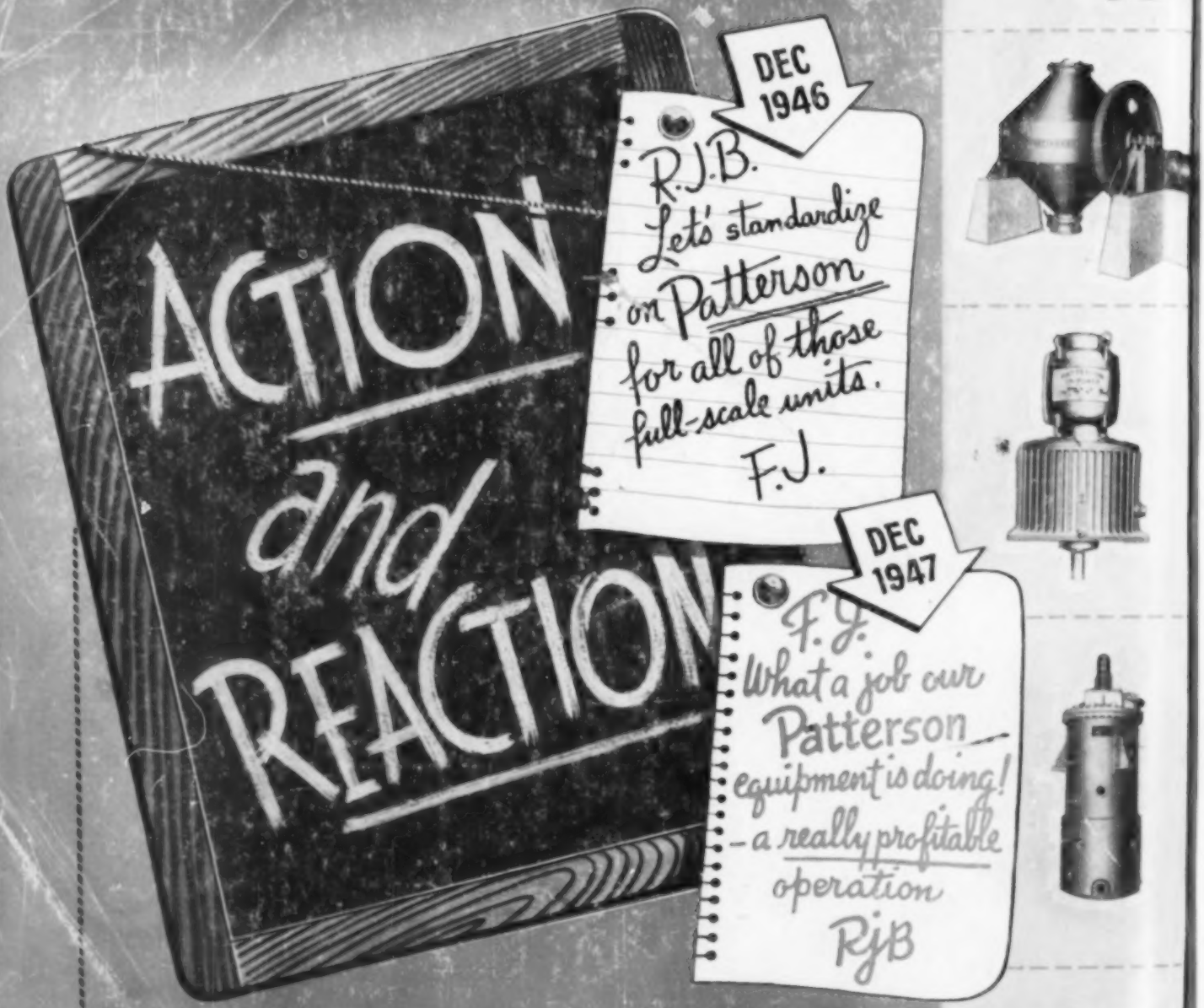

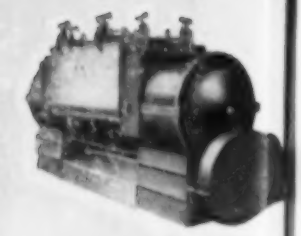

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